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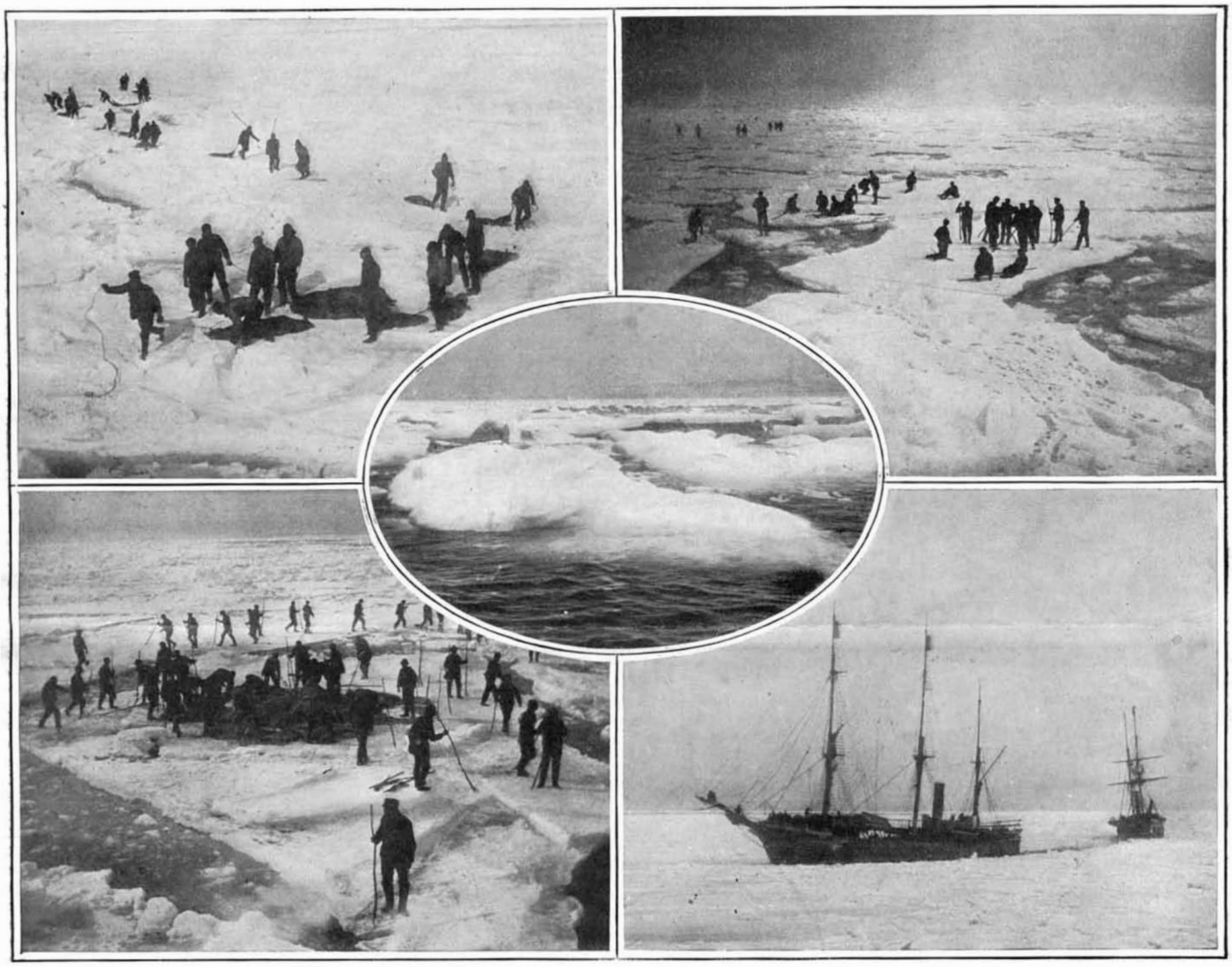
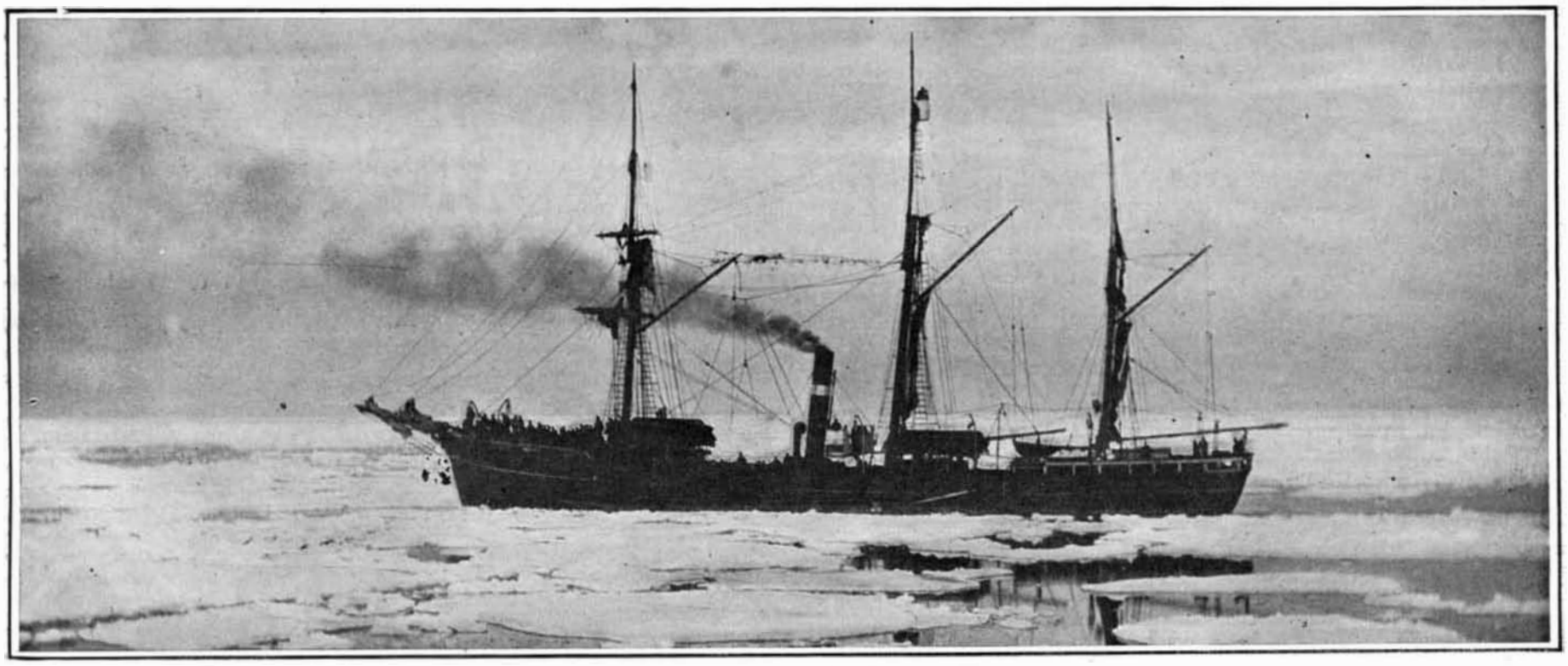


Dragging Seal Carcasses to the Steamer.
Pile of Dead Seals Ready to be Towed to Ship.

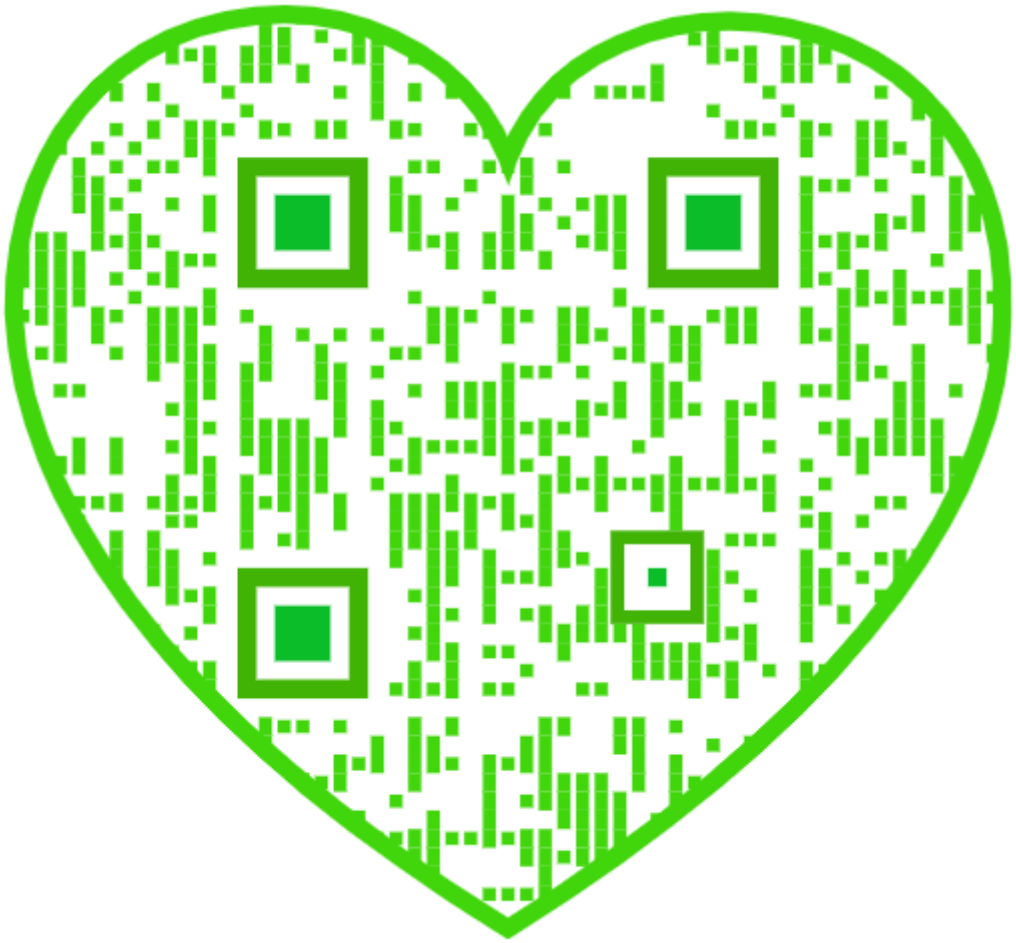
Ice Floe on the Labrador Coast.

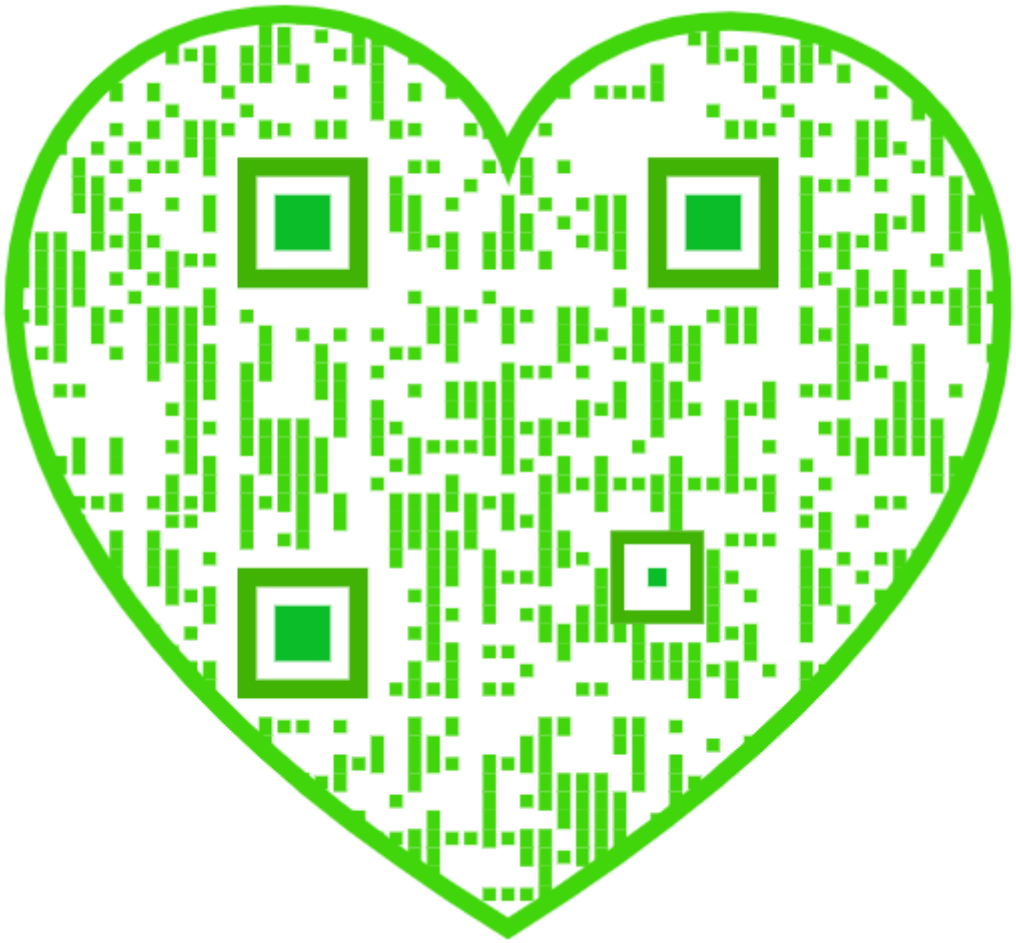
Gunning for Seals.
Sealing Steamer on the Sealing Grounds.



Sealing Steamer Among the Ice Floes.

HOW SEALS ARE KILLED OFF THE COAST OF LABRADOR.—[See page 308.]





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NEW YORK, SATURDAY, APRIL 13, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ELECTROLYSIS IN ARMORED CONCRETE.

One of the strongest recommendations for the use of armored concrete, and for the use of concrete as a protective envelope for structural steel in tall buildings, is the fact, or the belief, that concrete effectually prevents the corrosion of the imbedded material. As far as we are aware, nothing has transpired where concrete has been used for structural or protective purposes under normal conditions, to shake this confidence.

The question has recently been raised, or rather revived, as to whether, under certain conditions, the steel of reinforced concrete may not be subject to the destructive effects of electrolysis. The revival of interest is due to some experiments recently made by Mr. A. A. Knudson, of this city, and reported a few weeks ago to the American Institute of Electrical Engineers. The experiments were carried out as follows: Some blocks of one-to-one Portland cement sand concrete were molded in a common metal water pail, with a piece of 2-inch wrought iron pipe placed vertically within the blocks to a depth of about 8 inches. When the blocks were three years old, one of them was placed in a tank of sea water, and another in a tank of fresh water, and direct current was fed to the iron pipes in the center of each block, the negative electrode consisting of a piece of sheet iron placed in the tank. A third block, similar to the other two, was placed in a tank of sea water but was not subjected to the electric current. After a period of thirty days the last-named block was found to be in perfect condition and the imbedded pipe was perfectly bright. But the two other blocks, which had developed cracks during the test, were easily broken open; yellowish deposits were found in the cracks, where the concrete had deteriorated to such a degree that it could be cut easily with a knife; and the pipes were considerably corroded, showing a loss of weight of over 2 per cent. Similar results were obtained in tests with blocks of standard Rosendale cement, made in the same mold, although in this case the blocks were tested thirty days after they had been made. The cracking of the concrete appeared as early as the sixth day of the test, and by the eighteenth day they looked as though they might fall apart. One of the pipes showed a corrosion similar to the pitting action of underground electrolysis, a hole ⅜ by 1 inch being formed through the wall of the pipe.

It cannot be denied that these results are of profound significance. They call for careful investigation on the part of concrete engineers, and the provision of special means of insulation in all cases where imbedded structural steel, or the reinforcing material of armored concrete, is liable to attack by stray currents in the neighborhood of wet foundations. The whole subject of electrolysis which, because of the exaggerated use to which it has been put by a sensational press, has not received from technical men the attention which it deserves, should be made the subject of a searching investigation with a view to determining the laws and limits of this form of corrosion.

IN TOUCH WITH THE CONDITIONS.

The method of studying transit conditions in this city adopted by Mr. Shonts, who lately exchanged the presidency of the Panama Canal for that of the Interborough Metropolitan Company, cannot be too highly commended. In order to acquaint himself with conditions, he has mingled with the crowds which overflow the various lines of travel during the hours of heaviest travel, and has thus been able personally to experience the intolerable discomforts to which those who are "caught in the rush" are daily exposed. As the result of his experiences he has frankly admitted in one of our contemporaries that "there is reason for the dissatisfaction of the people with the present transit system." As a means of relieving the congestion Mr. Shonts makes the following suggestions:

First: A seat for every passenger. Second: An effort to enforce a car-full-no-more-passengers rule. Third: A trial of the pay-as-you-get-on plan. Fourth: Two more tracks on the Second Avenue elevated road. Fifth: The addition of side entrances to the Subway cars. Sixth: Wider car platforms, with doors for the exclusive use of boarding passengers, and others for those alighting. Seventh: Such restrictions of street traffic where congestion is greatest as will allow the surface lines a reasonable, although not exclusive, use of the tracks.

Taking these suggestions *seriatim:*

The provision of a seat for every passenger except, perhaps, at the height of the morning and evening "rush," depends absolutely upon the Interborough Company. It is merely a question of the provision of more cars, or shall we say, of the abolishing of the present practice of withdrawing cars from service between the rush hours to such an extent that there must of necessity be a large number of unseated passengers. If the company is sincere in the wish thus expressed through its president, it can, with its present facilities, provide every passenger with a seat—on some lines at every hour of the day, and on all lines except at the height of the rush hour.

It is questionable whether the enforcement of a car-full-no-more-passengers rule, as adopted in European cities, would meet with favor in America. Excellent in theory, it would scarcely be workable in practice, at least in a city like New York, where the tide of travel is always overflowing the transit facilities. But the principle back of such a rule is a good one, and it should certainly be applied to the extent of limiting the number of standing passengers to those who can conveniently be accommodated in the aisles of the cars, leaving the platforms free for ingress and egress.

The pay-as-you-get-on plan, we presume, includes the use of tickets which could be obtained of agents or at booths on the street corners. If passengers were encouraged to buy tickets in sets of a dozen at a time, the institution of ticket booths could be limited to the more congested districts, and the use of tickets would have the great advantage of allowing the conductor to remain where he properly belongs, on the rear platform. The passengers would thus be saved from the great inconvenience of the conductor crowding his way through the aisles to collect fares; and he would be free to attend to his duties of starting and stopping the car from a position where he could properly take care of the embarking and alighting passengers.

Although the construction of two additional tracks on Second Avenue would greatly relieve the congestion, the objection on the ground of unsightly appearance must be considered to be insuperable. All future tracks must be built in subways.

The next two suggestions are the most valuable of all; for nothing would increase the carrying capacity of the Subway and surface cars more effectually than the provision of side entrances on Subway cars, and wider car platforms with separate doors for boarding and alighting passengers on both Subway and surface cars. It is not the speed between stations but the duration of stops at the stations which determines the average speed of the trains and the number of trains which can pass over a certain line in a given time; and the length of the stops is determined entirely by the facilities for loading and unloading. As we have often pointed out, the present end doors and narrow platforms are about the crudest and most absurd arrangement that could possibly be imagined for rapid transit or even street railways. We believe that the express service on the Subway during rush hours could be made to show an increase in capacity of twenty per cent, and the local service of forty per cent, by the provision of central doors and platforms of double the present width, with separate doors for entrance and exit.

The last suggestion of Mr. Shonts, that street traffic be restricted where the congestion is greatest, should receive the most careful consideration of the authorities. Such restriction presupposes a due consideration of the interests both of the traveling public and of the owners of the vehicles—carriages, automobiles, and trucks—which would be affected, and in some cases seriously affected, by such restriction. Judged on the grounds that the greatest good of the greatest number should always be sought in adjustments of this kind, it would seem that some form of restriction on the more crowded thoroughfares, particularly during the rush hours, ought to be imposed. As matters now stand, the inconvenience suffered by the public, as the result of the interference of trucks and slow-moving vehicles with the movement of the surface cars, is simply enormous. In fact, on some stretches of line, the number of passengers carried per hour must be fully 75 per cent below that which could be carried, if vehicular obstruction were removed.

The President of the Interborough Company is to be congratulated both upon the common-sense method which he has adopted in his investigation of the transit situation, and upon the general excellence of the remedies proposed. His action will go far toward restoring that mutual confidence and sense of mutual interest between the corporations and the public, which will form the best guarantee of an early reversal, or at least amelioration, of the present conditions.

A NEW THEORY OF GUN EROSION.

One would have thought that at this late day, after so many years of painstaking investigation, all the conditions that produce gun erosion would be well understood. Erosion of the bore began to cause anxiety to the artillerist as far back as the days of black powder; it was present in more marked degree in the days of brown powder; and smokeless powder, with its higher temperatures and pressures, has increased the trouble to such a degree that it has been accepted by the Bureau of Ordnance of the army as the controlling factor in the design of artillery; as witness the fact that three coast defense guns have been ordered whose caliber, pressures, and velocity have been determined entirely by the necessity of keeping down erosion and so prolonging the life of the gun. Throughout the whole of this period of the development of modern ordnance, the trouble of erosion, because of its magnitude, has received as much, if not more, attention than any other element connected with the construction of high-powered guns. The announcement that the erosion question must predominate absolutely the design of our guns might reasonably be taken to indicate that the subject was now thoroughly understood in all its bearings; that its causes were clearly defined; and that, except in unimportant particulars, there is nothing further to be learned about it.

And yet at this late hour, a theory of the fundamental cause of erosion is advanced which is so simple and reasonable that one fails to understand how it could have been overlooked for all these years. We refer to the theory advanced by our correspondent in a letter published elsewhere in this issue, that it is the stretch of the metal and enlargement of the diameter of the bore under the pressure of the powder gases, which, by providing an annular opening between gun and projectile at the instant of explosion, permits the gases to escape past the projectile, that causes the erosion of the bore. Whether the gun be built of hoops shrunk one upon another over a central tube, or of miles of wire wrapped under high tension around the tube, the walls of the gun consist in either case of highly-elastic material overlaid on and gripping a tube of elastic material, the latter being thrown by the tension of the former into a condition of permanent compression. When a charge, no matter how small, is fired, the pressure produces a corresponding stretch of the walls of the gun. The amount of stretch will increase with the increase of powder pressure, until, under the 18 to 20 tons to the square inch which exists in the powder chambers of modern smokeless powder guns, it becomes sufficient to spring the bore of the gun away from the projectile and allow the gases, particularly in the first few feet of the movement of the projectile down the bore, to escape freely past the shell. Moreover, at these high pressures there must be a proportionate compression of the projectile. When to the annular opening thus formed is added the vents which are due to imperfect seating of the copper rifling band, it can readily be understood that there must be a considerable escape of gases, particularly under the high initial pressures of discharge.

Now herein, in this stretching of the walls of the gun away from the projectile, is a strong argument in favor of the contention that it is insufficient obturation or sealing which lies at the bottom of the erosion trouble, and if this be the case, we certainly fail to see how the proposed army 14-inch gun, whose walls will be reduced in thickness proportionately to the reduction in pressure, can be expected to cure erosion. The amount of stretch of the gun is determined by the relation between the degree of pressure and the amount of metal opposed to it; and since, in all well-designed guns, this ratio is fairly constant, we may look for the same, if not more stretch, or enlargement of the bore in the new 14-inch guns, and the same escape of gases, with its inevitable eroding effects. The erosion will not be so great as in the present 12-inch guns, for the reason that the temperatures will be less; but we believe that it will be sufficient to greatly disappoint the hopes of those who look for a considerable prolongation of the life of the gun.

It is evident, from what has been stated above, that the formation of an annular vent between bore and projectile is inevitable, being inherent in the principles upon which guns are constructed. Therefore, the cure for erosion seems more than ever to lie in the direction of the proper sealing of the base of the projectile. We know of no subject to-day in the field of ordnance construction that is more worthy of the efforts of prop-

erly-qualified inventors than that of devising some adequate means of meeting this greatest of all artillery problems.

THE VALUE OF THE NILE BARRAGES TO EGYPT.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A considerable amount of criticism has been made in many quarters regarding the utility and value of the expensive barrages that were thrown across the River Nile at Aswan and Asyut respectively, for the purpose of damming back the waters during the season of plenty and for the purpose of improving irrigation conditions during the season of drought, the necessity of which improvement has been so severely felt in Egypt for many years past. These barrages were erected at enormous expense, and it is contended that the benefits that they have succeeded in rendering to the country are insignificant in proportion to the amount of money devoted to their construction. But the pessimistic contentions have been refuted conclusively by Sir William Garstin, G.C.M.G., the Adviser to the Ministry of Public Works, in the course of his report concerning the administration of his department for 1905, recently published.

The year under review was a particularly suitable one for testing the value of the barrages and reservoirs to their utmost, since the country was in dire distress owing to the low state of the Nile, the supply from which river was bad during the whole year. The season started ominously, the level at Aswan being abnormally low, while during the months of June and July the readings at the gage station upon the upper reaches of the river between Aswan and Khartoum were the lowest that have ever been recorded. The crops were in serious danger; and had it not been for the water impounded above the dam, a very considerable proportion must inevitably have been lost. Sir William Garstin steadfastly asserts that "it is impossible to overestimate the benefits caused to Egypt by the Nile reservoir in 1905, and that the services it rendered to the country in this year alone have fully justified the cost of its construction."

For some few years past the country has been passing through seasons of severe drought in accordance with the well-known cycles of scarcity and plenty, which in this country alternate with infallible regularity; but the year 1905 appears to have been one of the worst ever recorded. The flood was altogether unsatisfactory. It was not only exceptionally late in arrival, but even when it did arrive was very poor. At one time the readings of the gages were so bad that the prospects, so far as Upper Egypt was concerned, appeared to be little short of disastrous. The maximum reading of the gage at Aswan was not reached until as late as September 18, and then it was not less than 35.43 inches below the average. The river fell rapidly, but in the last days of November the fall slacked off, and by the end of the year the levels at Wadi-Halfa were very similar to those obtaining in 1904.

At Wadi-Halfa the gage throughout the year was considerably lower than the average of the fifteen previous years. At Aswan the rise did not arrive until July 20, which was a very late date. The maximum reading R. L. 91.90 was not attained until September 18, and even then it was 35.43 inches below the average as already mentioned.

The water commenced to fill the reservoir upon November 3, 1904, when the Aswan gage had reached R. L. 88.50, being the level at which it becomes practically free from silt. The full level of R. L. 106.00 was attained on January 3, 1905, and the reservoir was then kept constant at that level until the commencement of the discharge. Owing to the indifferent readings indicated by the more southerly gages and the prospects of a very late, poor, and slow rise of flood, it was deemed advisable to maintain the reservoir water in reserve until May 1, when the discharge was carried out upon the following basis:

	Cubic feet per day.
May 1 to 31	282,512,000
June 1 to 15	494,396,000
June 16 to 30	565,024,000
July 1 to 12	706,280,000
July 13 to 18	494,396,000

The gradual reduction during the last six days kept the gage readings at Aswan practically steady until the approaching flood commenced to raise the river level. In the regulation of this supply passing out of the reservoir, the object in view was to maintain a steady rise in the river, so as to meet the steadily increasing demand in Middle and Lower Egypt by at least an increasing supply.

To what extent this regulation attained the desired object may be gathered from the report of Mr. Verschoyle, I. G. I., who asserts therein that one-third of the total canal supply of Middle and Lower Egypt was derived from the reservoir during June and July. There was a severe dearth of water during the latter month, which without the aid of the reservoir would have been disastrous. The regulation of the discharge through the sluices of the barrage is always a delicate and difficult operation, entailing very careful calculations and observations. During this year under review the difficulties in this direction were considerably augmented, owing to the fact that operations upon the construction of the extensive aprons for protecting the dam were in progress, so that only part of the sluices could be used.

The division of the summer supply of the river between Middle and Lower Egypt differs each year, owing to the annually increasing perennial area added to the former district by the conversion of the basins. An estimate was made of the "Sefi" areas, upon which was based the proportion of the supply to be given to each. It was thus arranged that the discharge withdrawn at Asyut for Middle Egypt should be 30 per cent of the discharge of the Delta canals plus 35,314,000 cubic feet of water per day. To render this arrangement practicable, the discharges of the Ibrahimiyah and Delta canals were interchanged. It was found feasible to adhere to this arrangement fairly closely until the end of the rotations, when the Ibrahimiyah canal took all it could draw with the level permissible above the Asyut barrage.

The regulation of the latter barrage was commenced early in February, and the maximum head attained during the summer irrigation was 62.9 inches. Regulation was continued throughout the flood on both the Delta and Asyut barrages. The whole of the gates, both upper and lower, of the Asyut dam were completely shut down during a great part of the flood.

Owing to the indifferent conditions prevailing, a decree was issued whereby the irrigation of fallow lands for the planting of flood durrah crops was prohibited from May 15 to July 28, before which date it was impossible to remove the restriction. The late date at which it was suspended was productive of several complaints, but it was found impossible to remedy the matter by a single day. The discharge from the Delta canals on the date of its removal was nearly double the minimum discharge, and yet the most difficult time of the whole year was the following week. The same decree was attempted in Middle Egypt; but owing to its novelty, due to the fact that this was the first time it was attempted, combined with the shortness of the notice, it was not successful, though it will be imperative to enforce it during subsequent years.

The summer rotations in Lower Egypt commenced generally on May 1, and ended between August 26 and September 1. A start was made with a 21-day rotation, that is to say, 6 days' watering followed by 15 days' stoppage, for ordinary crops, and a 9 days' rotation comprising a 4 days' watering followed by 5 days' stoppage for rice crops, respectively. As this supply fell short of the actual requirements, these periods between waterings had to be increased, and the periods of working reduced at the tails of sections. It is calculated that for a 21-day rotation the discharge at the Delta canals should not be less than 1,536 million cubic feet of water per day. As this discharge could not be attained until July 10 the greatest difficulty was experienced in distributing the supply. Had the cultivation of rice been suppressed—a step which would have promoted considerable dissatisfaction—a discharge at the Delta of 1,306,618,000 cubic feet would have been adequate, and Mr. Verschoyle contends that the only means of insuring this end is the restriction of the rice area.

In Middle Egypt summer rotations were commenced between April 1 and 15, and continued until nearly the end of July. In the old perennial area a 19-day rotation was started, which was gradually increased to 22 days, and once in July to 23 days.

During the period of 88 days from May 1 to July 28, when the rotations were in force, it is estimated that the mean discharge available in the Delta was 1,563,467,381 cubic feet per day. The area under ordinary crop was 1,414,642 acres, and under rice 178,142 acres. On the basis that each acre of rice is equivalent to 2 acres of ordinary crops, this gives an average of roughly 890 cubic feet per acre of rice, and 1,780 cubic feet per acre of ordinary crops per day. Such a maximum and minimum, as Mr. Verschoyle rightly points out, is very short commons; and it means, he continues, that in three years' time, if no extra source of supply is available meanwhile, in a year like 1905 the summer rice cultivation will have to be totally suppressed and a very severe rotation adopted for other crops.

With regard to the flood, the commencement of the rise was very late and the levels during August very bad. In September the levels improved and saved the situation, but the fall in October was very rapid. The maximum levels on the Aswan gage for 1905 and the five previous floods are as follows:

	Inches.
1877	287.5
1888	315.5
1899	301
1902	297.5
1904	309.875
1905	306.5

Thus it will be seen that though the flood of 1905 was not so bad as the very low floods of 1877, 1899, and 1902, it was worse than those of 1888 and 1904. Warning of the pending state of affairs was duly extended in full time, and the instructions obtaining for the regulation of supplies to the basins in such times of drought were issued. The Irrigation Department, however, have now become so skillful in their dealings with bad floods, that it is scarcely possible for any improvements in their methods to be made, but at the same time such contingencies tax their skill to the utmost, cause considerable anxiety, and entail ceaseless vigilance on their part, since the slightest mistake might promote serious consequences.

The areas of Sharaki, despite the abnormal conditions prevailing, were considerably reduced, as comparison with the previous low years will show:

	Acres.
1877	776,611
1888	277,183
1899	193,781
1902	132,522
1904	48,277
1905	34,052

The doubt is expressed as to whether under existing conditions this could by any means be reduced in extent. Although the area actually left unirrigated is comparatively small, still there is a very much larger area which receives very inadequate irrigation in a bad flood, and the series of low floods during recent years has resulted in a deterioration of a considerable amount of basin land. Attempts are to be made to remedy this defect in the Keneh province, which suffers severely, by a barrage now in course of construction by Sir John Aird & Co., of London, who carried out the dams at Aswan and Asyut, across the river at Isna for regulating the flood levels. This work and the subsidiary canals will be completed about the end of the year 1909. The greater part of the unwatered area in 1905 was on islands and on the river foreshores. Such localities lying outside the basin area are consequently impossible to protect.

Sir William Garstin considers that for the country to have passed through such a critical year with no loss of the summer crop, and with such an insignificant area of "sharaki," constitutes a remarkable achievement, and reflects great credit upon the Irrigation Department, at the same time conclusively testifying to the fact that the costly barrages of Aswan and Asyut, far from being the failures the pessimists would have us believe, are slowly but surely working out the salvation of Egypt.

A Curious Madagascar Plant.

In a paper presented to the Académie des Sciences, M. Hanriot gives an account of the active substances which are contained in the *Tephrosia Vogelli*. The leaves of this plant and neighboring species are used for fishing by the natives of Madagascar and the east coast of Africa. The plant is crushed and the pulp macerated with a little water; then it is put in the pond or river at different places, especially in slow streams. Soon the fish become paralyzed and mount to the surface. They can then be caught by hand and eaten without danger. M. Hanriot secured a quantity of the dried plants and isolated the different principles, first making a study of the leaves. The dried leaves are somewhat less active, however, than the green ones, but retain most of their properties. He distills the alcoholic extract of the leaves in a current of water vapor, and this brings over a liquid which is separated in part by decanting. This oily liquid he calls *tephrosal*. The non-distilled part is evaporated *in vacuo*, and from it, by means of chloroform and ether, he obtains a colorless crystalline substance called *tephrosine*. As regards the liquid substance tephrosal, it is a strong-smelling liquid having the formula $C_{10}H_{16}O$ and is volatile. It begins to distill in a vacuum at about 60 deg. C. It is but slightly soluble in water, but more so in alcohol and ether. Its aqueous solution reduces ammoniacal silver nitrate and cupro-potassic liquid in the cold, and it restores the color to fuchsine when it has been removed by sulphurous acid. Coming to the solid substance tephrosine, it is formed of small, brilliant prismatic crystals, melting at 187 deg. C. and volatile at a high temperature with partial decomposition. It can be distilled *in vacuo* without changing. Water will hardly dissolve it, nor alcohol, but it is easily dissolved in acetone or chloroform. Tephrosine does not contain nitrogen, and it answers to the formula $C_{31}H_{26}O_{16}$, being a neutral body. In chloroform solution, it will combine with bromine. This solution, when evaporated, gives a yellow residue which is very soluble in ether, whence methyl spirit precipitates it. Different experimenters have isolated, even from the *Tephrosia*, a number of analogous principles having toxic properties for fish. Among these are timboïne, taken by Pfaff from the Timbo plant, also the dorride and the pachyrizide, isolated by Van Sillevold from the *Derris elliptica* and the *Pachyrizus angulatus*, but these bodies, although analogous, are not identical with the above.

SEAL HUNTING ON THE ICE FLOES OF THE NORTH.

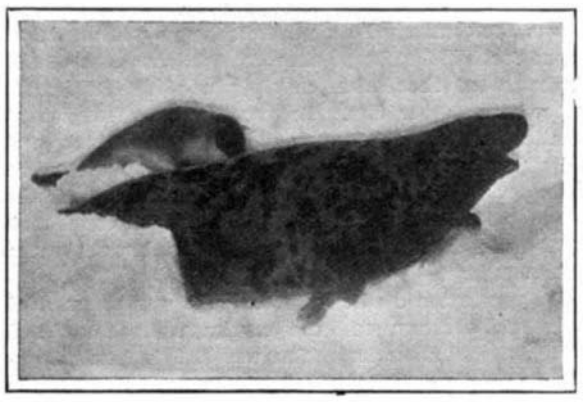
BY ALLEN DAY.

One of the most perilous of the world's vocations, but one in which an army of from five to seven thousand men take part, is the seal hunt, as it is called. The scene of the hunt is the ice fields which drift southward in the spring of each year from the Arctic regions, and a bleaker or more desolate region could scarcely be found than this great icy waste. The prey of the seal hunters, however, is of enough value to tempt them to brave the rigors and dangers, for the hair seal which is their quest is of especial value. Not only is its coat valuable, but the blubber of the young yields an oil much prized for different purposes.

The Arctic current which sweeps southward through the ocean along the coasts of Labrador and Newfoundland carries with it a variety of animal life, being one of the great feeding grounds for deep-sea fish such as cod and mackerel. The low temperature of the waters, and the fact that for such a large portion of the year great masses of ice drift upon them, ranging from the glacial berg to the floe, render the Arctic current a fit habitat not only for many varieties of fish, but for the seal referred to. The ice floes form the cradle of the young, where they are cared for by the mothers during the first few weeks of their existence. The fine pelt which forms the coat of these young seals is especially prized by the seal hunters, for the reason that it can be manufactured into leather which is utilized extensively for making trunks, boots, as well as book bindings. The oil referred to commands a high price, being used for illumination, for lubrication, and for the manufacture of fine toilet soaps.

There are four species of seals in the waters around Newfoundland and Labrador—the bay seal, the harp, the hood, and the square flipper. The bay seal is local in its habits, does not migrate like the others, but frequents the mouths of rivers and the harbors near the coast. It is never found on the ice. Mostly taken in nets, it is commercially of small importance. The harp seal—the seal of commerce—is so called from having a broad curved line of connected dark spots proceeding from each shoulder and meeting on the back above the tail, and forming a figure something like an ancient harp. The hood is much larger than the harp. The male, called by the hunters "the doghood," is distinguished from the female by a singular hood or bag of flesh on his nose. When attacked or enraged, he inflates this hood so as to cover the face and eyes, and it is strong enough to resist seal shot. When thus protected, he can be killed only by shooting him in the neck and the base of the skull. The doghood fights desperately in defense of his mate and young ones, and if they are killed he becomes furious, inflates his hood, while his nostrils dilate into two huge bladders. His appearance is now terrific, and with uncouth floundering leaps he rushes on his foe. Instances have occurred where a fight between an old doghood and five or six men has lasted for an hour; and sometimes a hunter is fearfully torn, and even killed, in the encounter. The square-flipper seal is the fourth kind, and is believed to be identical with the Greenland seal; it is from twelve to sixteen feet in length. It is only occasionally met with in these seas.

The seal industry of Newfoundland is determined by the migratory movements of the seals. These are as regular as the flow of the Arctic current. About the middle of February their young are born on the ice-fields off the northeast coast of Newfoundland. The young are suckled by their mothers for six weeks, and about the 1st of April they take to the water. Early in May they commence their northerly movement in company with their young, shaping their course for the Greenland seas, where they spend three months. As the early Arctic winter sets in with September, they begin their southern migration, keeping ahead of the ice as it forms, and moving toward the coast of Labrador, feeding in its fiords and bays as they move. Small detachments seem to lead the way. Days are occupied in passing certain points, and the sea as far as the eye can reach seems filled. This great army on its march may well impress the beholder with the



Seals on an Ice Floe.

idea of the vast number of seals, on whose ranks the hunters make their annual onslaughts.

Having reached the Straits of Belle Isle, separating Newfoundland from Labrador, one division enters the Gulf of St. Lawrence, the other moving along the eastern shores of the island, feeding in its bays and inlets, but both divisions steadily going south. Toward the close of the year they have reached the Banks, these being their southern headquarters, as the Greenland seas are their northern. The Banks are ever swarming with fish, and on these the seals feast till the beginning of February. Then they commence their northern migration to meet the Arctic ice, on which their young are to be brought forth and cradled. By the 10th or 15th of February they have reached the ice-fields descending on the Arctic current. These great floes are the birthplaces of their young.

The seal hunt is conducted by picked men from the island of Newfoundland, usually fishermen who are accustomed to long voyages on this portion of the Atlantic. Only strong and hearty men are allowed to secure a berth on the sealing steamers. The vessels are strongly constructed, so as to withstand not only the winter gales in the North Atlantic, but also the pressure of the ice masses in which they are frequently imprisoned. The hulls are usually composed of wood, but the bow is generally filled with timber for several feet, in order that the ship may ram the ice in working a passage through it without being injured. The bow and hull below the water line are also further protected with iron plates. All the vessels carry sails, and are provided with steam power as well. Some of them are noted in Arctic exploration, having gone far north in the quest of the pole.

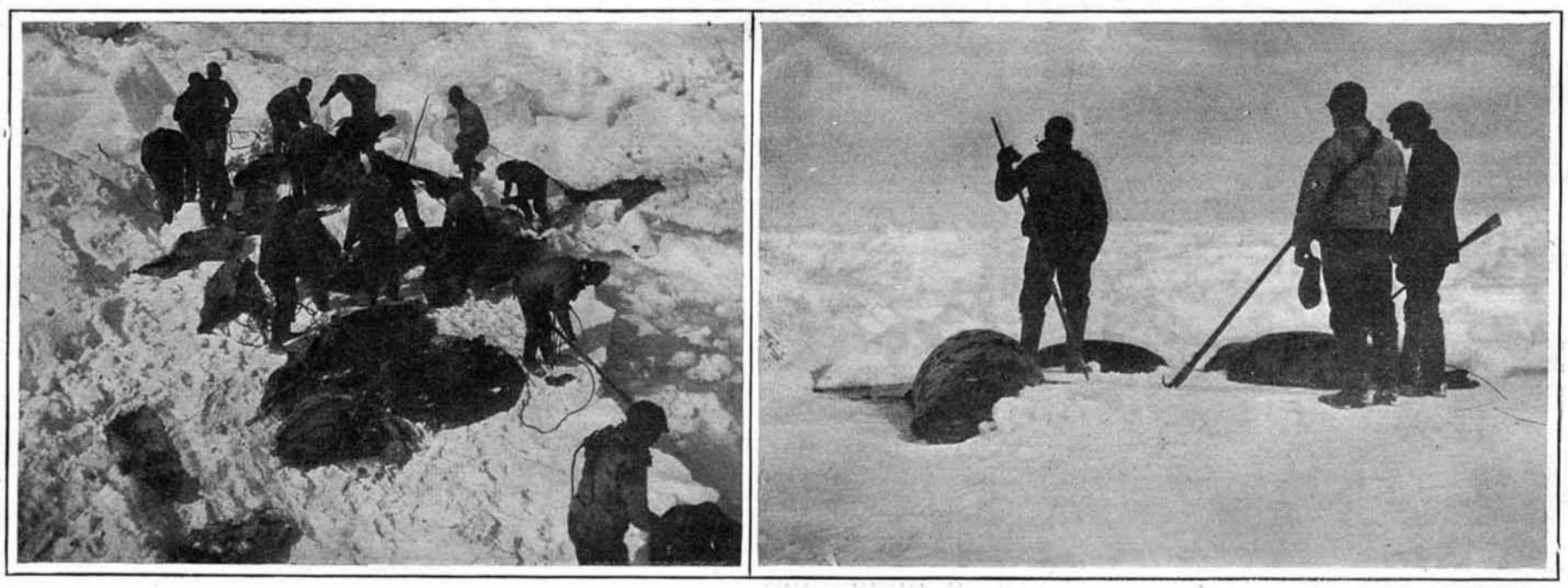
The voyage of the seal hunters may last for two weeks or six weeks. It all depends on how soon the lookout sights the seals coming down on the ice fields. If the "seal pans" are reached at night, the presence of the animals is frequently recognized by the whimpering of the young, which can be heard a long distance. As soon as the ship reaches the habitat of the animals, it may be moored to the edge of the ice-field or may remain in the open water near by. Every man who can be spared is landed, and immediately the work of killing begins. A blow on the nose from a gaff, heavily shod with iron at one end, fractures the thin skull of the young seal, and in the vast majority of cases it feels pain no more. Death is instantaneous. In a moment the knife is at work. The skin with the adhering fat is detached rapidly from the carcass, which is left on the ice, still quivering with life, though there is no sensation, the movements of the muscles being merely mechanical, and caused by contact with the icy surface. In fact, death comes to the young "whitecoats" far quicker and with less pain than to animals slaughtered by the butchers. The pelts, as the skins and adhering fat are called, are then bound up in bundles and dragged over the hummocky ice to the side of the steamer.

As already stated, the old seals frequently attempt to defend their young, and are killed as well. The skull and the hide of the dog seal are frequently so thick that he cannot be killed with the gaff used on the younger ones. He is then shot with a rifle. Each squad of seal hunters carries at least one gun intended for this purpose. The men do not cease in their work until there are no more victims or night closes in. Sometimes they get several miles away from the vessel, and are obliged to remain on the ice cake until morning. This is a very perilous situation, for the reason that at times gales come up which break the fields into small pieces, or blizzards come in which many a hunter has been frozen to death.

When the vessel reaches port with her cargo, the skinners go to work and separate the skins and the fat. The former are salted and stored for export. By means of steam-driven machinery, the fat is cut up by revolving knives into minute pieces, then ground finer by a sort of gigantic sausage machine, afterward steamed to extract the oil, and then exposed for a time in glass-covered tanks to the action of the sun's rays, and finally barreled for exportation. The annual catch of seals ranges usually from 200,000 to 300,000. Nearly all of the skins go to the United States.

The cargoes of seal pelts are, of course, large or small, according to the number of animals found on the ice. Sometimes a steamer may fill her hold in two weeks. Another may be out for six weeks, and return only with a few thousand skins. Much depends upon the skill of the captains in locating the seal patches, and as the ice-fields may be over a hundred miles in breadth and of unknown length, the sealer may be weeks running along the edge of the field before he sees any dark spots which show the presence of the prey. Occasionally, however, the vessel comes into St. Johns harbor with the broom aloft which shows that she has been unusually successful. One of the largest cargoes ever brought to this port was that of the steamer "Neptune," whose crew secured 42,000 seals in eighteen days, the pelts filling not only the hold, but being piled upon the decks as well.

A paper recently read by Prof. O. P. Hood before the American Society of Mechanical Engineers gave the results of a test of a high-duty engine used in connection with an air compressor. The engine is quadruple-expansion, uses steam at 250 pounds pressure, and is provided with a feed-water heating system which obtains a large credit of heat from the engine to return to the boiler. The duty of the engine per million heat units, based on the indicated work, is 194,930,000 foot-pounds. The heat used per hour per indicated horse-power is 10,157 B.T.U., establishing a new record for a steam engine 9 per cent below the best previous record. The thermal efficiency of the engine exceeds 25 per cent.



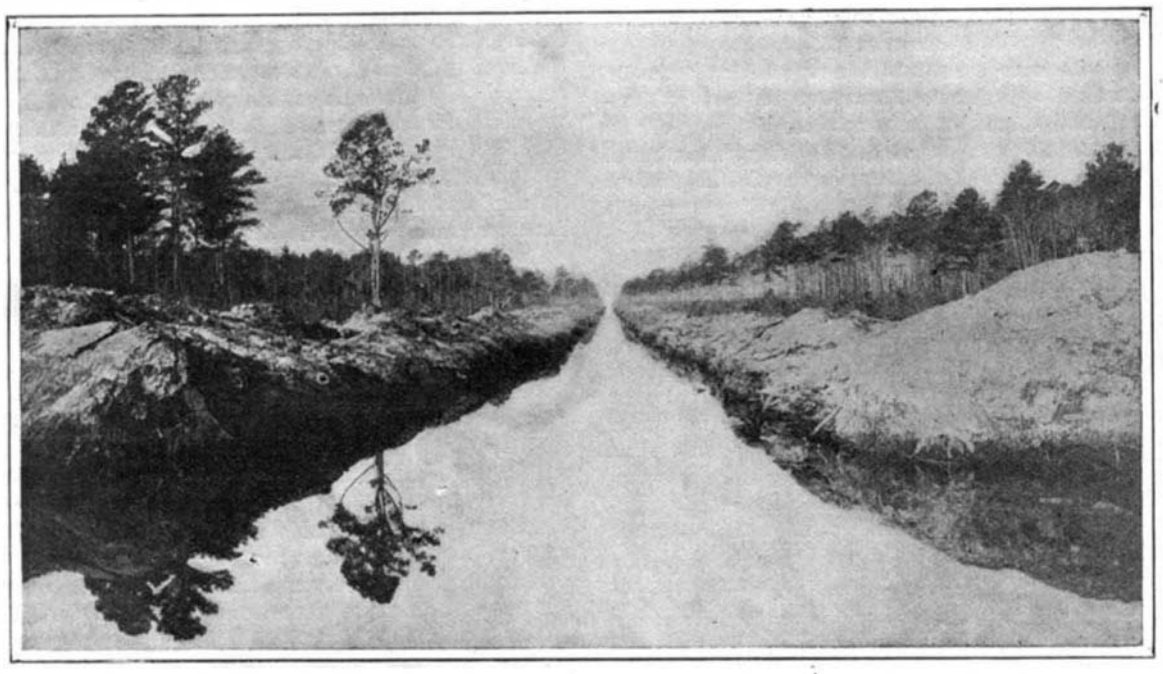
"Unlacing" Men Disengaging the Seals from the Towing Ropes. **The Dog Seal Was Shot and the Mother and Cub Clubbed with the Gaff.**

HOW SEALS ARE KILLED OFF THE COAST OF LABRADOR.

THE NORTH CAROLINA-VIRGINIA INLAND WATERWAY.

BY H. L. WILSON.

The Congress which recently adjourned passed one of the most important, if not one of the largest, rivers and harbors bills in recent history. Among other things it provided recognition of the North Carolina-Virginia inland waterway, which has been before the public for some seven years, and for which surveys were authorized in the rivers and harbors acts of 1902 and 1905.



Abandoned Cutting on Route of Canal, Showing Character of Country.

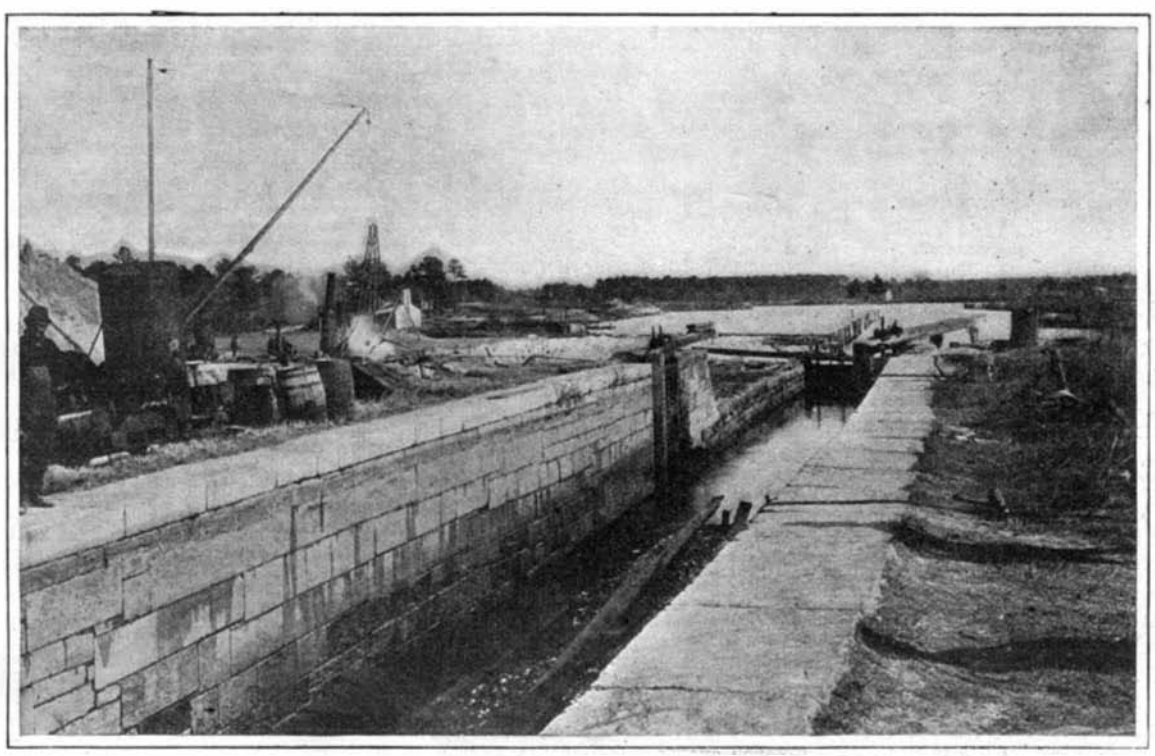
The reports of the engineers making these surveys considered carefully all available routes, and decided that two were so nearly equal in advantages and disadvantages that the monetary consideration alone should form the deciding factor. These two routes are known as the Albemarle and Chesapeake canal and the Cooper Creek routes respectively, the former contemplating the purchase of the already existing Albemarle and Chesapeake canal, which connects Chesapeake Bay *via* Elizabeth River with Currituck Sound; and the latter neglecting the purchase of that canal and digging a new one from Elizabeth River to Cooper Creek, a branch of the Pasquotank River, which is an arm of Albemarle Sound. With the purchase price of the already existing Albemarle and Chesapeake canal at a figure not exceeding $500,000, the former is recommended. If the price asked is higher, the latter route is recommended. While no expression of opinion which is in any way official can be obtained from the canal company, it seems to be the general impression that the amount named is sufficient to make the purchase assured.

The objection which has always been urged against the construction of this waterway is that it is a purely local measure, benefiting people of a comparatively small section. Its friends, however, vigorously combat this view, and bring forth in substantiation of their claims a number of facts and statements which are worthy of consideration. There is no doubt of the fact that coast trade, as far as low-price freight is concerned, is practically a non-existent factor in southern transportation, because of the terrible dangers of Cape Hatteras, the "Deadly Diamond" as the shoal is known, and the famous Hatteras "saw teeth," which supply the victims for the "Graveyard of the Atlantic." Small boats, barges, and lighters carrying freight simply do not attempt the outside passage, ten months in the year, on account of the difficulty of rounding the Cape and the danger of going ashore on the shoal, with a total loss of property and an almost equally certain total loss of life. The opening of the inland waterway will completely circumvent these dangers, as a glance at the map will make evident, allowing a complete inland passage to be made from Chesapeake Bay to and through Beaufort Inlet, below both Capes Hatteras and Lookout.

Canal Connections with Natural Bodies of Water Will be Frequent, Where the Canal Enters a Small Lake, as Shown in This Photograph.

Commercial organizations throughout the South have indorsed the measure, and the southern delegations have stood for it in a solid mass, but until this last Congress it has always been throttled in committee. This time, however, in spite of the opposition of Chairman Burton, the appropriation was made. Unfortunately, the appropriation considers only a 10-foot depth of the canal, in the face of the emphatic reports of the engineers that a 12-foot canal was what was wanted and a 10-foot canal totally inadequate to the needs of those who will use it. The reason is plain. The most economical barge, of moderate size, is the barge with a 10-foot draft. That is, considering first cost, insurance, carrying capacity, speed, and towage charges, a barge of 10 feet draft pays better than one of 8 or one of 12. Consequently, a 12-foot canal and sound dredging was indicated—Congress provides a 10-foot waterway. It is pointed out that a 10-foot canal really means nearly 12 feet, as more is always excavated rather than less. It is also easily seen that in future years a comparatively small appropriation will add the additional two feet—much easier to obtain than was this original recognition.

The local benefits are enormous. An immense territory, with one of the greatest systems of natural waterways in the world, is landlocked, because there is no opening to the landlocked waters save through the canal to Chesapeake Bay. None of the inlets to the various sounds—Bogue Sound through Beaufort Inlet, Pamlico Sound through Whalebone, Ocracoke and Hatteras Inlets, or the upper end of Pamlico Sound near Croatan and Roanoke Sounds through New and Oregon inlets—is available, since these passageways are continually choked up with drifting sand, which piles up almost as fast as it is taken away, with the exception of Beaufort Inlet, where the waterway will empty into the ocean below Lookout. But Core Sound is so shallow that Beaufort Inlet, even if dredged without the construction of the waterway, would give no available inlet without great cost to the various sounds which form the inland water system of the North Carolina coast.



Lock of the Present Albemarle and Chesapeake Canal; to be Widened When Incorporated in the New Waterway.

As the project stands at present, the surveys have all been made, and $550,000 appropriated to do the work on the third division; that is, the lower end of the route. This includes four miles of solid excavation from the Neuse River to Beaufort Inlet through Core Creek—the only solid excavation necessary in the entire route, if the Albemarle and Chesapeake canal forms a part of it. According to the estimate of the engineers in the last report, this excavation and the dredging necessary to open Pamlico Sound to the third division—to connect the sound to the ocean, in other words—would amount to:

Excavation, 4,120,000 cubic yards.
Length of cuts, 14 miles.
Cost at 12½ cents per cubic yard, $515,000.
Right of way, 600 acres at $25 per acre, $15,000.
Bridges, $20,000.
Total estimated cost, $550,000.
Total length of route, 50 miles.

The ideas in commencing work on the third division instead of the first are several in number. In the first place, it will immediately open the ocean to all the existing light-draft traffic of the various sounds. In the second place, it will immediately put behind the most objectionable part of the work, the solid excavation; and in the third place, it will allow plenty of time to make the purchase of the Albemarle and Chesapeake canal, or to lay plans for the digging

THE NORFOLK AND BEAUFORT CANAL.

of the Cooper Creek canal, in the unlikely event that the canal could not be bought. There is no question that the establishment of the new route will make the Albemarle and Chesapeake canal a useless property, if its owners insist on retaining it, consequently it is considered a foregone conclusion that they will sell rather than suffer a loss. The price dictated by the engineers was simply the one which would be economical for the government to make the purchase with—and is in no way a "force-out price." It is, moreover, a large and therefore more than fair price for the length of cut it is designed to purchase.

The mechanical and engineering difficulties are few and small in number. The earth is soft clay and sand mixed, easy to remove with steam shovels and dredges. The climate is somewhat malarious, but the opening of almost all new waterways is that. Insect pests will probably prove a minor vexation. It is not known, and cannot be known, whether all the dredging excavations in the various sounds will result in permanent channels, particularly in the narrow Croatan Sound, where a stronger current and higher waves are met with than in any other place on the route. But the engineers recommended a maintenance plant, and a certain amount to be appropriated yearly for keeping the waterway open, rather than submitting this part of the work to contract; and such a recommendation will undoubtedly be adopted. If Croatan or Currituck Sound fills up the dredged channels, therefore, the maintenance plant will simply be kept busy upon them when necessary, dredging out what the waves and wind fill in, very much as dredges are almost continually at work on the large and important channels in the great harbors of the world.

The photographs show the character of the work to be done, and there is one class of structure which need not be repeated, namely, wooden revetment for the banks; this is admitted by the present Albemarle and Chesapeake canal management to have been an unnecessary investment and practically a waste of money.

Work will probably be started as soon as the season opens, and continued right along, further appropriations being called for as the work progresses. The entire waterway will be built, of course, by United States army engineers.

The British Naval Programme for 1907.

Pursuing the policy adopted for 1906, the British naval programme for the ensuing year shows a still further reduction, the estimates for 1907 being $7,135,000 below those of the preceding year. The total sum required for the naval defenses for the current year is $152,212,045, of which total the expenditure upon new construction will absorb $40,500,000, a reduction of $5,675,000 as compared with the appropriation to this end for 1906. According to the Parliamentary papers devoted to the question, many important innovations are to be made during the coming year, the most important feature of which is to be the creation of a new striking force to be known as the Home Fleet.

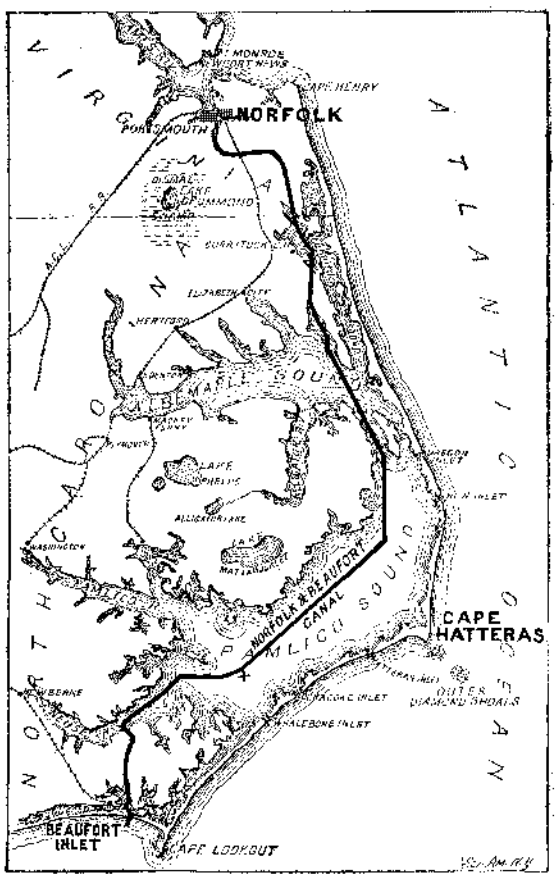
The constructional programme is of great importance, emphasizing as it does the complete success that has attended the evolution of the "Dreadnought" class of battleships. At least two similar vessels are to be laid down, the number to be increased to three should the coming discussion among the powers at The Hague Conference regarding the limitation of armaments prove abortive. These vessels will be of somewhat larger dimensions and displacement than the "Dreadnought," and the experience that has been gained with the latter vessel in regard to armament, details of construction, and motive power will be advantageously incorporated in the proposed warclads. Furthermore, an improved design of heavy gun, trials with which have proved eminently successful, is to be adopted for the arming of these vessels, but particulars concerning their caliber and so forth are withheld. In addition, 1 fast armored cruiser, 5 destroyers, 12 torpedo boats, and 12 submarines are to be commenced. With the exception of 1906, when no cruisers were laid down, the present is the smallest British cruiser programme on record. It is generally realized, however, that the coming of the "Dreadnought" class of battleship, which has not yet been fully proved, places the cruiser in a somewhat transient stage, and the present decision to limit strictly the number of cruisers is influenced by these conditions.

During the past year 4 first-class battleships, 3 armored cruisers, 11 submarines, and 7 first-class torpedo boats have been completed and passed into the navy, while there are at present under construction 5 battleships, 7 armored cruisers, 17 first-class torpedo boats, 8 ocean-going destroyers, and 12 submarines.

During the trials of the "Dreadnought" great secrecy was maintained concerning the behavior of the turbines with which it is equipped; but that this propelling machinery is eminently adapted to naval requirements under all and varying conditions is substantiated by the statement that "the results obtained in the 'Dreadnought' and in the other turbine-propelled vessels which have been completed this year justify the adoption of this type of propelling machinery for his Majesty's ships, and this policy is being continued in all war vessels of this year's programme." It will thus be seen that the year 1906 marks an important era in naval engineering by the virtual passing of the reciprocating engine by the rotary motive power, so far as Great Britain is concerned.

The decision to constitute a new striking force by the creation of a Home Fleet, due to the readjustment of the balance of power in consequence of the Russo-Japanese war, is of far-reaching importance. By the distribution of the naval strength the present nucleus crews of ships in the first fighting line will be considerably augmented, while there will be complete manning of squadrons of six battleships and six armored cruisers which will not leave home waters. In addition to these 12 first-class ships, there will be 48 destroyers with full crews, some small cruisers, and the requisite auxiliaries concentrated at the Nore, and these will be maintained on a footing ready for any emergency. The term "in reserve" will no longer be applicable, since all sea-going ships in home ports not belonging to fleets or squadrons will become apportioned to the Home Fleet, and will be so maintained as to be able to proceed to sea with full crews at a few hours' notice.

During the past year a considerable improvement has been effected in regard to the gunnery. In battle practice, by which the gunnery organization of the ship as a whole is tested, and which is therefore the best criterion of efficiency, the average number of hits per ship was practically double that of the previous year, notwithstanding the fact that the 1906 tests were of a more severe nature, the mean range having been increased to 1,000 yards, and the time available for firing restricted to one minute or less.



Map Showing the Route of the Norfolk and Beaufort Canal for Which Congress Has Recently Appropriated $550,000.

In the gunlayers' test with heavy guns, the average number of points obtained per man was 80.065, representing an increase of 11.805 per man upon the previous year; or comparing the percentage of hits to rounds fired, it was 71.12 as compared with 56.58. With regard to the quick-firing guns, the percentage of hits to rounds fired rose from 21.63 in 1905 to 34.53 in 1906. In the battle practice of the torpedo-boat destroyers the increase was equally well maintained, the percentage of hits to rounds fired being 20.05 in 1905 to 34.6 in 1906. This improvement is general throughout the whole fleet, and is not confined to a picked selection of crack ships. As a result, the British fleet as a whole, both as regards vessels and personnel, is in a greater state of efficiency than it has been before for a number of years, and this improvement gives every prospect of being well maintained.

The United States Drainage Commission tests have shown that the best circumferential velocity for the impellers of centrifugal pumps is approximately 50 feet per second. This would represent, for example, a whirl velocity through the discharge of the impellers of, say, from 30 feet to 40 feet a second, which velocity must be slowed down to 12 feet per second or less in the discharge piping connected with the pump.

Correspondence.

The Moth and the Flame.

To the Editor of the Scientific American:

An interesting article, "The Moth and the Flame," which appeared in the Scientific American some time ago, is undoubtedly correct.

One night as I came upstairs to my room I heard the buzzing noise of a large number of moths beating against the window in trying to get through. It was very dark in the room, but the window was somewhat illumined by moonlight, and for that reason the moths were trying to get out by way of the window. I am satisfied that for them lightward means outward, while darkward means inward.

As soon as I struck a match, for the purpose of lighting the lamp, they all rushed toward it, apparently assuming that there was an opening.

After the match was out they flew around a little, and then returned to the window. As soon as I noticed this, I remembered what I had read, and tried the experiment again, with the same results.

When the second match was out, I lighted my lamp with a third one. After the lamp had been burning a few seconds, they left the window and rushed against the chimney again and again. This, according to my opinion, is pretty good proof of what the writer of the article mentioned above told the readers of the Scientific American some time ago.

New Braunfels, Texas. W. Mittendorf.

The New Army 14-Inch Gun.

To the Editor of the Scientific American:

According to the Army and Navy Journal, it is the intention of the Ordnance Department to build three 14-inch guns at once. This would indicate that the department intends to build these guns and mount them for service without subjecting one to an endurance test. If such is the intention, it seems to be a very unwise and dangerous plan, for an emergency might arise and these guns be found to be unfit for service after a very short action.

I am sure it is unwise to build the proposed 14-inch guns for many reasons to which you have called attention in your valuable paper, such as higher angle of elevation, shorter danger space and danger zone, heavier ammunition, longer time of flight, fewer shots in a given interval of time; to say nothing of the expense involved in building them. There is another and far weightier reason for not building them:—the object desired—a longer-lived gun—will not be obtained. Especially is this true if the department builds, as the chief of ordnance has reported it will, a 14-inch gun as light or lighter than the present 12-inch gun which it is to replace. I am sure it will be no longer-lived; in fact, I should not be surprised if it proved to be even shorter-lived.

The short life of a gun is due to scoring or erosion. This scoring results from two causes. The first you have several times pointed out, i. e., faulty obturation before and at the time the rotating band takes the rifling. The second cause, which increases the effect of the first cause and carries the effect farther down the bore, has been apparently overlooked by investigators of this question.

In building guns the bore is placed under a condition of initial compression either by shrinkage or by winding wire under a tension. In either way the effect is the same: the bore of the gun is made smaller by this compression. Now in action, the pressure of the powder gases tends to overcome this initial compression and so must enlarge the bore of the gun while it is at the same time compressing the heel of the shot. This leaves a space through which the gases rush past the rotating band and score the walls of the gun.

The first of these two causes has been recognized by Major Peirce, of the Ordnance Department, in his investigation of the scoring in shoulder arms. The effect of the second cause is not so great in the shoulder arms, for the reason that the scoring effect is overcome once the bullet is well seated in the bore, by the upsetting of the bullet by the pressure of the powder gases against its base, and the further facts that the bullet has a long bearing surface and a diameter of 0.308, while the diameter of the bore at the bottom of the grooves is but 0.306 and the shoulder arm is rifled with a uniform twist.

This expansion of the gun under pressure accounts for the fact that the scoring is greater on the lands than in the bottom of the grooves, for when the bore is expanded away from the shell by the powder pressure, the tendency of the gases to move in a straight line carries them across the lands which, offering the more vulnerable surface, are the more scored. It also accounts for the fact that with the same pressures and velocities the greater the bore the shorter the life of the gun, for under the same pressure a 12-inch gun would expand twice as much as a 6-inch gun and cause the gun to score at least twice as fast. This is true with the thickness of the

walls of the gun in proportion to the caliber of the gun. It is the intention of the department not only not to have the thickness of the walls of the gun proportionate to the caliber, but to have them actually thinner than the walls of the present 12-inch gun. Under such conditions I am sure the proposed 14-inch gun will expand as much under the pressure necessary to give 2,000 f. s. as does the bore of the present 12-inch gun under the pressure necessary to give 2,500 f. s., and therefore score as much or more and be even shorter-lived.

From a careful study of the star-gaging reports of the two 6-inch wire guns recently tested at Sandy Hook, I am convinced that with proper banding and uniform twist of rifling the life of the gun can be materially increased without reducing the present service velocities. I am positive it is possible so greatly to reduce the scoring as to render it unnecessary to reduce velocities and to permit even of increasing them.

I regret and deplore the expenditure of so much money to build guns which, once it is proved that scoring can be materially reduced, will be so much scrap steel. Why not build 12-inch guns on the lines of the two 6-inch wire guns recently tested at Sandy Hook? Such guns would give the required 2,500 f. s. with pressures far below 30,000 pounds, and with proper banding and uniform twist of rifling would have a life of fully 300 rounds. They would have the additional advantage, once it is proved that scoring can be materially reduced, of having a service velocity of fully 3,500 f. s. and still have a life of fully 300 rounds.

J. H. BROWN.

Gyroscopic Action of Electric Locomotives on Curves.

To the Editor of the SCIENTIFIC AMERICAN:

A note by Mr. C. H. Kennison in the SCIENTIFIC AMERICAN of March 16, 1907, upon the possible importance of the gyroscopic action of electric motors in cars upon curves, gives rise to an interesting line of thought. Practically, it is scarcely probable that the effect would be appreciable, although we must admit the existence of some such action. It may be of interest to look a little more in detail into just what various forces are concerned.

At the outset it is necessary to call attention to one very common misapprehension as regards gyroscopic force. It is commonly said that a wheel rotating in a given plane offers a resistance to any force tending to change the plane of rotation. This statement is not strictly true. If the axis of rotation of a rotating wheel is moved angularly in a given plane, the gyroscopic force thus developed does not directly act to oppose the motion, but acts in a plane at right angles to that in which the axis moves, tending to deviate it one way or the other. This can be plainly seen by holding a rotating gyroscope in the hands, and attempting to move backward or forward one end of the axis, when it will be found that no immediate and direct opposition exists to the motion in the horizontal plane, but only a force tending to raise or lower the end of the axis. The fact that the gyroscopic force always acts at right angles to the plane of change of direction of the axis cannot be too strongly impressed upon the mind. What is commonly spoken of as the resistance of the wheel to a change in its plane of rotation is only a secondary effect of the gyroscopic force, and is very prettily illustrated in the ordinary gyroscope.

In the common form of gyroscope, the axis when first released falls vertically. The gyroscopic force, or couple, as it really is, does not act in any way to oppose this fall, but simply to deviate the direction of motion from the vertical. The axis therefore takes an inclined path. As the path becomes more and more inclined, the gyroscopic force, always at right angles to the plane of motion of the axis, is directed more and more upward, gradually destroying the fall and deviating this motion into the horizontal direction. The gyroscopic force is now directed upward, opposing the attraction of gravitation. The gyroscopic force begins now to deviate the axis upward at the same time, becoming itself more and more directed backward. The path of the axis hence gradually curves upward until finally the axis comes to rest at the same level as before, but pointing in a different direction. Another loop is described in a similar manner, and so on and on a succession of minute arcs. Hence we see, generally speaking, that the gyroscopic force supports the apparatus, not by direct opposition to the falling, but secondarily by its ability to deviate the motion of the end of the axis into the series of little arcs referred to. A special case arises however when, by a rather common combination of circumstances, the axis attains a certain uniform horizontal velocity, which produces a gyroscopic force just sufficient to support the weight of the apparatus. In this case nevertheless the gyroscopic force, directly opposed to the attraction of gravitation, in no wise opposes the motion of the axis in the horizontal plane.

Let us consider now from a purely theoretical standpoint the question raised by the communication above referred to. Assume the armature of the motor to be directly applied to the axle of the wheels. So long as the track remains straight, the plane of rotation remains unchanged, and no gyroscopic effect results. When the car strikes a curve however, the plane of rotation is forced to change one way or the other, the axis of rotation changing direction in a horizontal plane. The result is the production of a force at right angles to this plane, tending to raise one end of the axis and lower the other. An analysis of the relative motions concerned will show that the gyroscopic force acts in such a direction as to raise the end of the axis nearest the center of curvature of the track, that is, that it tends to overturn the car. The result is the same, no matter which way the track curves. This observation can be easily verified by experiment with the gyroscope held in the hands.

If on the other hand we assume the motor to be geared to the axle so that the armature rotates in the opposite direction to the car wheels, then the tendency of the gyroscopic force is to prevent overturning as the car rounds the curve.

In either case, however, if it is granted that the car does not overturn, it is obvious that the gyroscopic force, being always directed in a vertical plane, can offer no opposition whatever to the change of direction of the car.

C. M. BROOMALL.

The Delaware County Institute of Science,
Media, Pa., March 18, 1907.

To the Editor of the SCIENTIFIC AMERICAN:

If you will allow me, I will correct the impression of your recent correspondents, who think the gyrostatic effect of the rotors of an electric locomotive resists the angular movement of the locomotive in going round a curve. A rotating body does not resist a change of plane unless it is free to gyrate, or turn on another axis normal to its axis of rotation. For instance, a gyroscope does not resist the effect of gravity unless it is free to turn in a horizontal plane. In the case of the rotors, being held rigidly as they are in their bearings, the effect of gyrostatic action would be to simply lift on one bearing and bear down on the other, depending on the direction of rotation.

Niles, Mich., March 26, 1907. W. G. BLISH.

The Current Supplement.

The current SUPPLEMENT, No. 1632, opens with a most interesting and exhaustive article on liquid crystals and theories of life. In this article Prof. Lehmann's experiments with liquid crystals are instructively reviewed. The article is elaborately illustrated. Mr. Arthur P. Davis's discussion of the inundation of the Salton Sink is concluded. An excellent paper is that by Mr. William North Rice on the permanence of continents. Those of our readers who desire to learn how half-tone engravings for the SCIENTIFIC AMERICAN and other publications are made should read the article in the SUPPLEMENT entitled "The Making of a Half-Tone Engraving." The chemical composition of tool steel and the more important characteristics of high-speed tools are considered by F. W. Taylor. In winding small induction coils, that is, those giving sparks up to and including two inches in length, the secondary may be formed of bare copper wire wound in layers on the primary helix instead of using insulated wire. How thus to construct small induction coils with bare wire is very clearly explained by Mr. A. Frederick Collins. So clear is his text, and so elucidating the illustrations which accompany it, that any one should be able to construct a bare wire coil by the mere reading of the article. Dimensions are given. Mr. W. H. Wakeman writes on pumping devices for open tank service. The shortly expected return of Halley's comet renders particularly timely Mr. F. W. Henkel's article on the subject.

Official Meteorological Summary, New York, N. Y., March, 1907.

Atmospheric pressure: Highest, 30.57; lowest, 29.55; mean, 30.07. Temperature: Highest, 75; date, 23d; lowest, 16; date, 7th; mean of warmest day, 64; date, 29th; coolest day, 24; date, 7th; mean of maximum for the month, 47.9; mean of minimum, 33.6; absolute mean, 40.8; normal, 37.6; excess compared with mean of 37 years, +3.2. Warmest mean temperature of March, 48, in 1903. Coldest mean, 29, in 1872. Absolute maximum and minimum of this month for 37 years, 75 and 3. Average daily deficiency since January 1, —0.2. Precipitation, 3.80; greatest in 24 hours, 1.03; date, 19th; average of this month for 37 years, 4.08. Deficiency, —0.28. Accumulated deficiency since January 1, —2.00. Greatest precipitation, 7.90, in 1876; least, 1.19, in 1885. Snowfall, 13.8. Wind: Prevailing direction, N. W.; total movement, 8,813 miles; average hourly velocity, 11.8; maximum velocity, 58 miles per hour. Weather: Clear days, 10; cloudy, 10; partly cloudy, 11. Fog, 13th, 14th. Sleet, 12th. Thunderstorms, 19th.

BRANCH RAILWAYS BY THE TELPHERAGE SYSTEM.

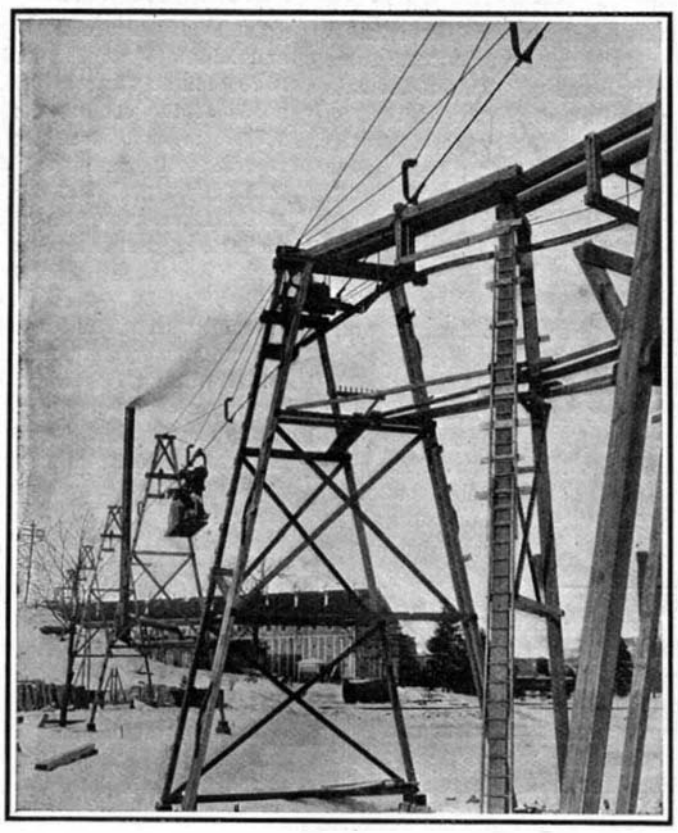
The building up of a vast railroad system like that of the United States is marked by two distinct periods: the first, that in which the main arteries of travel are pushed boldly out over the territory to be covered; and the second, that in which these main lines are made accessible for the outlying regions they traverse, by the construction of branch or feeder lines. The railroad system of this country has passed through the first phase, and it is not likely that many, if any more, great trunk lines will be projected. Also, in the East and Middle West, the main feeders to the trunk line have been so far constructed, that they will serve the needs of the country for many years to come. The 220,000 miles of track in the United States probably represent the sum total of trackage of the standard broad-gage type that would yield a profitable return on the investment, if it were worked with the full complement of rolling stock that it is capable of carrying.

At the present time the railroad situation may be said to be face to face with yet another phase of development, which will consist, not in the construction of heavy, broad-gage track carrying heavy rolling stock of the standard type, but of light railways, either of the narrow-gage surface, or of the light overhead type, cheap to construct, cheap to operate, and having a capacity, at least in the case of overhead lines, far exceeding that of any known system of land transportation. Although the narrow-gage railway has met with considerable favor in some European colonies, it has failed to meet the conditions of traffic in this country, its capacity being too small for heavy traffic, and its cost too great for the needs of those sparsely-settled districts where, for the present at least, freight and passenger movements must necessarily be infrequent and small in quantity. Nevertheless, the demand for some inexpensive and easily-constructed railway system which would bring the vast farming districts of the West and Southwest into direct communication with the railroads is most imperative. Could some system of cheap feeder lines be devised, not only would the value of these farms be increased, but the settlement of the sparsely-settled districts would be greatly stimulated; for such a connection would rob the vast prairie lands of the West of those associations of loneliness and isolation which, doubtless, serve to prevent many would-be settlers from making their homes there.

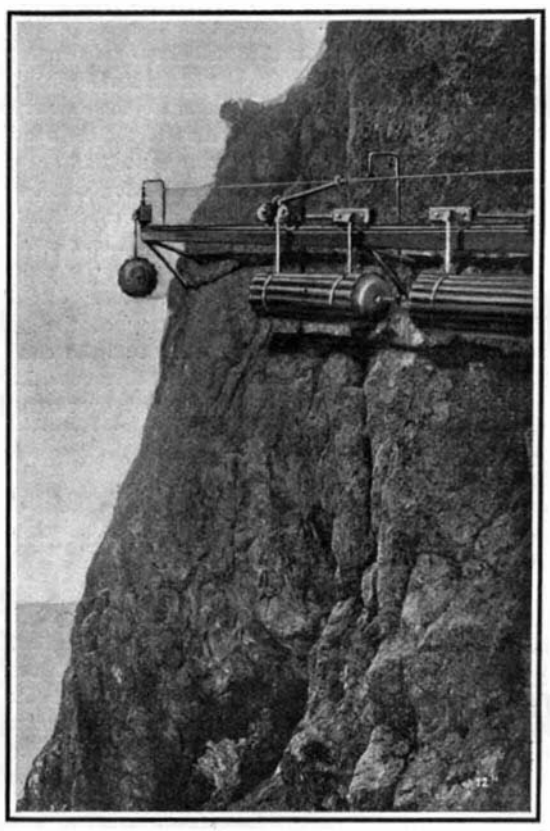
The leading railroad men of the day have been devoting much attention to the system of telpherage, which forms the subject of the accompanying illustrations, with a view to adapting it to the needs of railway service, and particularly to the demand, as above mentioned, for an inexpensive system of branch railways in sparsely-settled country. It is particularly suited to the conditions; for it is cheap to construct, inexpensive in operation, and possesses a flexibility as to capacity which is unequaled by any other method of transportation. The nature of the construction and the simplicity of operation of the Common Carrier Telpherage System, as it is called, are clearly shown in the accompanying drawing, which was made from a description furnished by Mr. John Brisben Walker, of this city, who is the owner of the common carrier rights for the United States, and all the telpherage rights for Canada. In this view, a typical telpherage line is shown starting from the siding of a broad-gage railway, crossing a river, and running into the country to be served, say for a distance of from 20 to 30 miles. The construction is of the most economical kind. It consists of two lines of 8-inch by 10-inch stringers with 20-pound rail, carried at the outer ends of a series of trestle bents consisting of 8-inch by 8-inch caps, spiked down upon posts, which may be of sawed lumber, or even of suitable lengths of common telegraph posts. The "trains" are made up generally of sets of four light corrugated-iron cars, circular in section, 4½ feet in diameter by 16 feet in length. Each car is supported by two light iron straps to two two-wheeled trucks. The forward truck of the motor car is provided with a motor and a short trolley pole engaging an overhead trolley wire. The crossing of rivers, canyons, or precipitous valleys is accomplished by supporting the cable or traveler wire from a series of suspender cables, passing over the tops of latticed towers, and guyed back to anchorages on either bank; the suspender wires forming a modified catenary, from which the traveler cable is supported at stated intervals, as shown in the engraving. A notable advanta of the system is that the method of support or sus sion of the track or cable is capable of wide vari to suit the topographical difficulties of the cou be traversed. Tunneling is unnecessary, since may be so developed as to cross the loftiest mountains, without exceeding the maximum grade of four cent; or, where rocky bluffs are encountered, it may be supported on iron brackets attached at intervals to the sides of the bluff, as shown in the a ompanying engraving.

In no character of country does the telpherage system show to better advantage than for transportation through the mountains. A railro in the West, which

has recently been completed, is said to include twenty tunnels in 20 miles of road—and any engineer who is familiar with the extraordinarily broken character of some of the western canyons, will understand that this is quite a possibility. When building a broad-gage mountain railroad through a precipitous canyon the road must often be carried continuously either on trestle, in tunnel, or on a ledge of road-bed which has to be blasted out of almost perpendicular cliffs, the side slope of the cut reaching, sometimes, several hundred feet up the mountain side. It will be seen from our engravings that by the use either of light trestles, suspended cables, or brackets and cantilevers anchored into the rocky walls, it would be possible to carry a telpher line, costing a few thousand dollars per mile, through a canyon in which the construction of a standard-gage steam track would run up in cost to $100,000 per mile and over.



Method of Supporting Telpher Line from Overhead Cable Carried on Trestles.



Tunnels Avoided by Carrying Line Around the Face of the Bluffs.

In addition to the cheap nature of the construction of the line, which in prairie and rolling lands can be built for $3,500 per mile, there is an equal economy realized in the construction of the rolling stock. The standard type of car for use under ordinary conditions would be cylindrical, with semi-spherical ends, and, being built of corrugated steel, it would possess considerable strength for a very moderate dead-weight. The two hangers would be of strap iron, and, because of the comparatively small size and weight of the cars, the overhead trucks would be also of light construction. Further economy would be found in the comparatively small amount of electric power that it would be necessary to install at the opening of a new line. As the speed of operation would only be about 12 miles per hour, a 20-mile line, such as would be built out from the steam railroad in order to tap one or two large wheat fields, say, on the level prairies of the northwestern country, could be operated with a plant of not to exceed 100 horse-power. This would suffice until the district had been developed, and a greater tonnage was available, when the smaller equipment could be used on some newly-opened line.

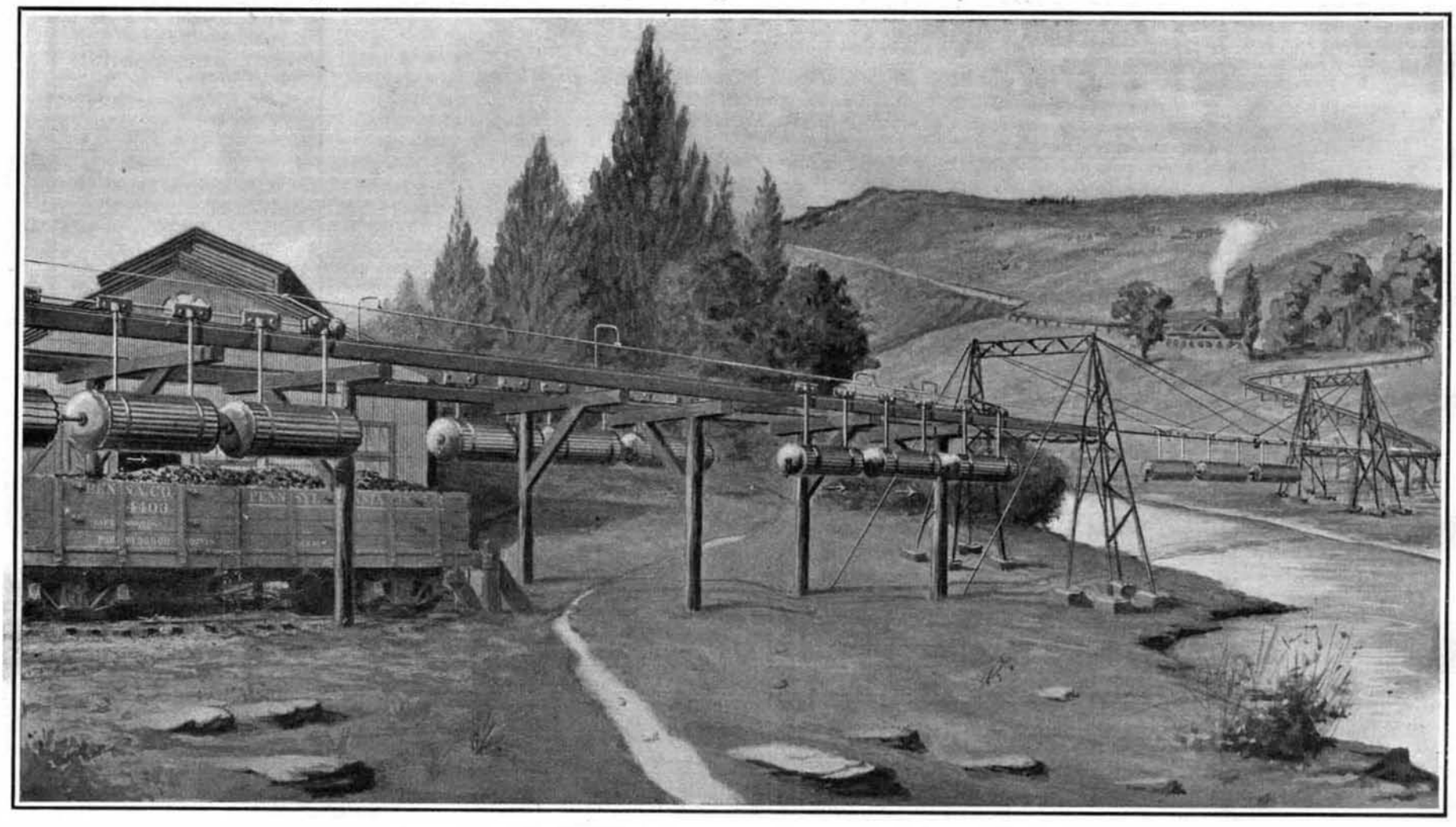
In addition to the cheapness of the line, the rolling stock, and the power plant, there would be a further economy in the character of the force required for operation. Since there would be no locomotives or heavy cars to handle, the train crew would be abolished at a stroke, and the operating force would be confined to one or two men at the power station. Even the switchmen would be unnecessary, for a train of cars could be automatically switched into a particular station, say 20 miles from the starting-point, by means of automatic trips, set to engage corresponding stops at the switch opening.

The accumulated economies which are peculiar to the telpherage system, as outlined above, render this not only the cheapest system of transportation of freight, but the one having the greatest capacity. It is estimated that with a telpher line operating under favorable conditions, freight may be carried at a cost of one-twentieth of a cent per ton per mile. This would occur when the line was loaded to about one-fourth of its full capacity; that is to say, if 25 per cent of the telpher line were occupied by the telpher cars. The system would have a remarkable capacity for the carriage of ore, coal, or wheat in bulk; for if the line were occupied to one-fourth of its capacity with loaded cars, traveling at 12 miles per hour, we would have the equivalent of a 4½-foot pipe line delivering grain or similar substance at the rate of three miles per hour. The enormous tonnage which would be handled in this way can be readily understood.

While speaking of the character of the cars, reference should be made to an economy of no small importance, which would be due to the fact that these cars could be carried direct into coal mines, loaded at the headings, hauled to the telpher line, loaded bodily into delivery trucks at their destination, and dumped in the coal bin or cellar without breaking bulk.

The important question of right of way is greatly simplified by the fact that the construction of the telpher line involves a minimum of interference with the property over which it is carried; for the cars could traverse a field of wheat without in any way interfering with the cultivation of the same. Furthermore, the system affords an excellent solution of the problem of overcrowded freight lines, such as the Erie Railroad presents; since the capacity of such a road could be doubled by transferring the carriage of the coal to an elevated telpher line, built on the right of way on each side of the steam tracks, thus leaving the latter for the exclusive use of mixed freight and heavy passenger service.

The Bureau of Navigation at Washington reports that for the calendar year 1906 the vessels built in America and registered numbered 1,045 of 393,291 gross tons; for 1905, 1,054 of 306,563 gross tons; for 1904, 1,065, of 265,104 gross tons; for 1903, 1,159, of 361,970 gross tons; and for 1902, 1,262, of 429,327 gross tons.



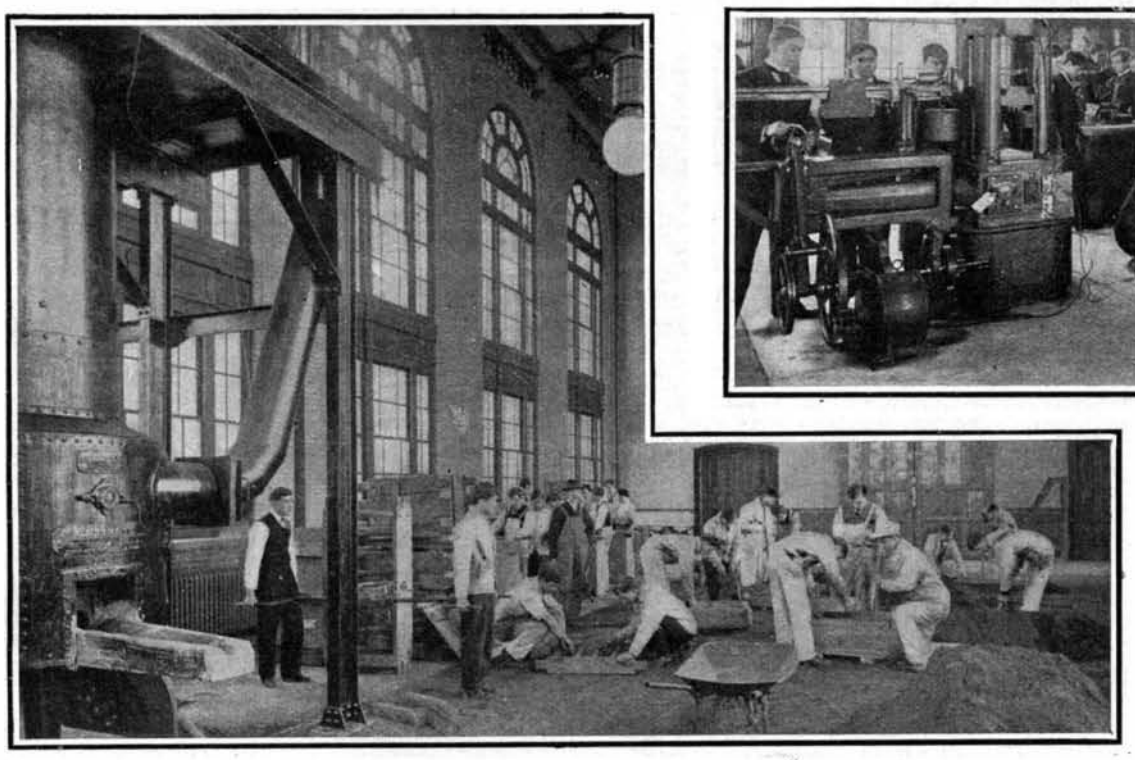
Typical View Showing Telpher Line Acting as Feeder to a Steam Railroad.

BRANCH RAILWAYS BY THE TELPHERAGE SYSTEM.

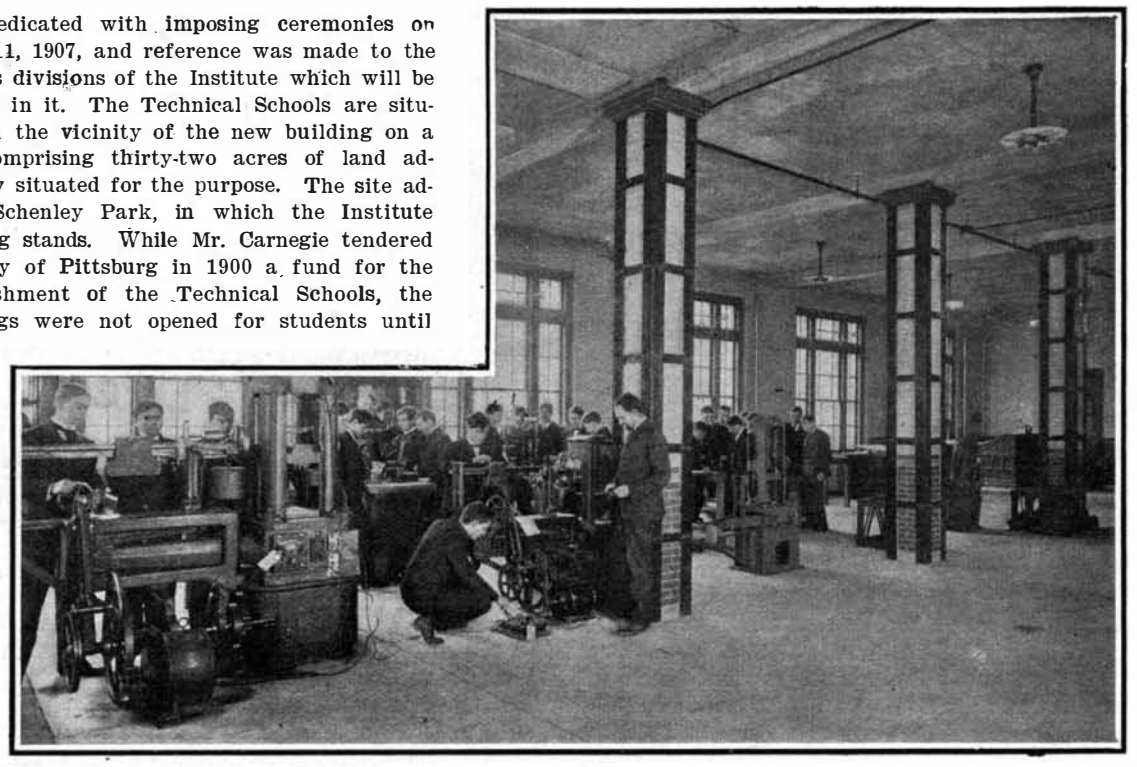
THE CARNEGIE TECHNICAL SCHOOLS, PITTSBURG, PA.

BY DAY ALLEN WILLEY.

The dedication of the new building intended for the library, art gallery, museum, and music hall of the Carnegie Institute at Pittsburg, calls attention to the group of Technical Schools, which is also a division of the Institute. While none of these is included in the new building, the magnitude of their scope, and the large membership of students who receive instruction in the various branches they comprise, make them one of the most important activities which are embraced in the Institute. The fund provided for establishing and maintaining the Technical Schools represents a considerable portion of the entire fund given by Mr. Carnegie to the city of Pittsburg—the amount aggregating nearly $20,000,000.



A Corner of the Foundry.



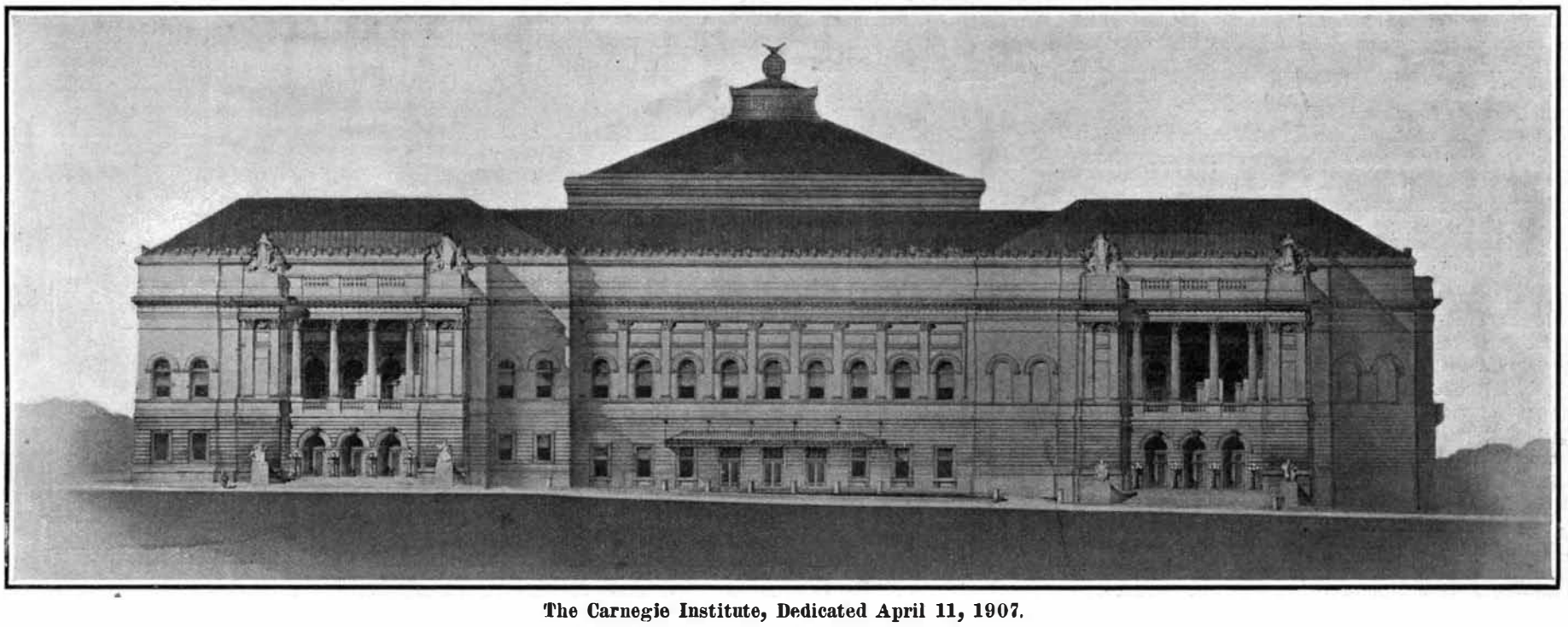
Testing the Strength of Materials.

In a recent issue of the SCIENTIFIC AMERICAN a description was given of the splendid structure which was dedicated with imposing ceremonies on April 11, 1907, and reference was made to the various divisions of the Institute which will be located in it. The Technical Schools are situated in the vicinity of the new building on a site comprising thirty-two acres of land admirably situated for the purpose. The site adjoins Schenley Park, in which the Institute building stands. While Mr. Carnegie tendered the city of Pittsburg in 1900 a fund for the establishment of the Technical Schools, the buildings were not opened for students until October, 1905. However, the people of Pittsburg and vicinity have already taken such advantage of the opportunities afforded for technical education, that during the past year the average attendance has been nearly 800.

While the great body of students has come from the city of Pittsburg, the many manufacturing suburbs of the community have contributed a large number, and it is evident that the various schools are reaching just the class of young people for whom they were especially intended. The buildings which have thus far been erected have a frontage of no less than 650 feet on Schenley Park, but the site they occupy has a total frontage of nearly a half mile, so that ample space is afforded for the proposed enlargements, which, when completed, will make this group one of the most extensive of its kind in the world. The architecture of the buildings, which is well shown in the accompanying illustrations, affords abundant light and ventilation, while, it may be added, the construction is practically fireproof.

From the standpoint of attendance, the School of Applied Science heads the group. Here about 500 students take the various courses which it offers. The instruction is given to night as well as day classes,

The Carnegie Technical Schools as They Are To-day.



The Carnegie Institute, Dedicated April 11, 1907.

THE CARNEGIE TECHNICAL SCHOOLS, PITTSBURG, PA.

A Class in Plumbing.

and includes such important subjects as Metallurgy, Industrial Chemistry, Electro-Chemistry, Structural Design, Railroad Construction, Municipal Engineering, Generation and Transmission of Electricity, Testing and Designing of Electrical Apparatus, Machine Design, Design of Prime Movers, Iron and Steel Manufacture, Location and Operation of Mines and Quarries, and Smelting and Refining.

From these topics it is evident that the student who desires to engage in mining, electrical industry, to become a civil engineer or merely a shop machinist, can fit himself for his favored vocation. The routine includes not only recitations and lectures, however, but practical demonstrations of subjects, as well as laboratory work, work in the field, and actual shop practice. It is calculated to complete the course selected in the period of three years for day students. Recognizing the needs of many who are occupied during the day, the Night School of Applied Science has been provided with courses covering five years, the instruction being given in Metallurgy, Industrial Chemistry, Structural Design, Municipal Engineering, Generation and Transmission of Electricity, Machine Design, and Design of Prime Movers.

The importance of art and design in technical education is recognized by what is termed the School of Applied Design. Although as yet but a beginning has been made in this direction, the interest shown indicates that this section of the schools will in time become one of the most important, since it gives the opportunity, both in the night and day sessions, for thorough instruction in such specialties as, for instance, architecture, and offers exceptional facilities to those who are already employed as draftsmen for perfecting themselves. The instruction is modeled after the noted atelier system of Paris, modified to suit American requirements.

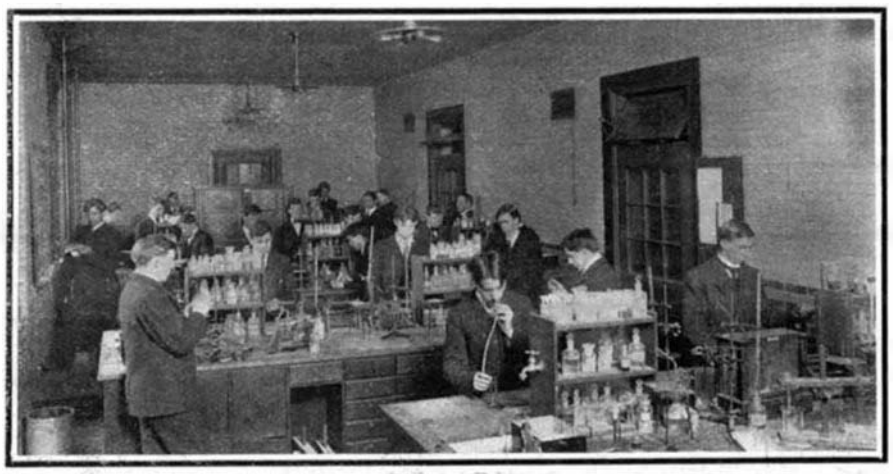
The School of Apprentices and Journeymen is divided into courses for each class of artisans, and it may be needless to say, it is closely associated with manufacturing industries of nearly all kinds. The aim of this school is to prepare young men for better and more remunerative service as machinists, pattern makers, blacksmiths, molders, plumbers, electrical wiremen, sheet-metal workers, bricklayers, house and sign painters, etc. The system of instruction has been designed to give the students a broader knowledge of their trades than it is possible for them to acquire by work in shops or on buildings under the prevailing system of minute subdivision of trades, which has succeeded the well-tried European system of apprenticeship, and has deprived the American mechanic of the opportunity to acquire a general training in his calling.

The school does not attempt to develop skilled mechanics, but offers courses of instruction to supplement the usual apprenticeship, to strengthen the reasoning faculties, and to teach both the theory and the practice of the trades to those who are gaining their whole knowledge through practical operations in their daily employment. The system of instruction is adapted primarily to those pursuing mechanical vocations, advancing them along their chosen lines, preparing them to fill higher positions when opportunity arises, and developing their natural talent and skill. Modern conditions make it imperative that the future mechanic be trained in the trade school in the same way and with the same efficiency as the modern engineer is trained in the engineering school, in view of the great growth and development of the country's manufacturing and building industries, which has created an enormous demand for properly-trained mechanics.

The calendar for the present year well illustrates the instruction given in this school. It embraces Machine Work, Pattern Making, Blacksmithing and Forging, Molding and Foundry Work, Plumbing, Bricklaying, Sheet Metal and Cornice Work, Electric Wiring, House and Hardwood Finishing, and Sign Painting. As in the other departments, ample provision is made for practice in the way of shop work, while mechanical drawing and mathematics are essentials.

The school for women is also divided into night and day sessions, and is specially notable for the variety of vocations in which instruction is given by experts. The young woman who enters the Carnegie School for Women has an opportunity to fit herself to become the matron or manager of such institutions as boarding schools, college homes, and children's homes, to become the housekeeeper or steward of a hospital, sanitarium, or hotel, to superintend the filing or recording of accounts and other data in factories and stores, or to become the secretary of the business or professional man or his confidential clerk. It will be recognized that the scope of instruction in this portion of the Institute is unusually broad, but in addition it trains women in dressmaking and designing and other vocations, so that they can become of valuable assistance in such establishments as department stores, dressmaking shops, and in other similar lines of industry. It would be impossible to give all of the details of the branches of instruction which are included in this school, but it may be said that it gives a practical education in as many skilled vocations for women as any institution in the United States, and has already trained a large number.

In planning the technical school, liberal provision was made for laboratory and shop work as well as study, recitation, and lecture. The mechanical students have access to fifty different machines for wood and metal working, all of which are of modern design and driven by individual electric motors, in addition to a number of smaller power tools intended for various purposes. One of the most interesting divisions is the materials laboratory, as it is called, where instruction and practice are given in machine design, prime movers, furnaces, and mill machinery. The laboratory contains nine sets of power-generating apparatus. An individual power plant has been installed for operating the mechanism in the schools, as well as for lighting and heating the building. In itself it forms an interesting object lesson to the student. The engine is one of the latest designs of the Westinghouse horizontal gas engine of the two-cylinder type, which is calculated to develop 470 electric horse-power at a speed of 150 revolutions per minute. The engine is direct connected to a 250-kilowatt three-wire generator, furnishing sufficient electrical current for light and power. The flywheel of the engine is 13½ feet in diameter and weighs 30 tons. For the purpose of economy, a Westinghouse gas engine of the vertical type is employed, developing 125 electrical horse-power. This is utilized when power and light are required but for a portion of the schools; it actuates a 75-kilowatt generator. The schools are heated by hot water from a battery of boilers, the water being forced through the pipes in the various departments also by means of electrical power, a variable-speed motor being employed.



The School of Applied Science.

The Physical Laboratory.

As already intimated, provision has been made for the enlargement of the technical schools. The attendance from year to year is increasing so rapidly that additional space will probably be required in the near future, although the present group of structures are of imposing proportions.

The Technical Schools are in charge of Mr. Arthur A. Hamerschlag, director, and a faculty of sixty-six professors and instructors, the secretary of the schools being Mr. William P. Field.

Announcement was made on April 5th of a gift of $6,000,000 from Mr. Carnegie to the Carnegie Institute, $2,000,000 of which is for the Technical Schools.

A Class in Mechanical Drawing.

THE CARNEGIE TECHNICAL SCHOOLS, PITTSBURG, PA.

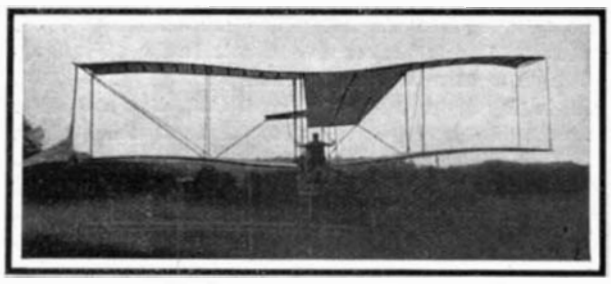
CAPT. FERBER'S AEROPLANE EXPERIMENTS.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One of the first of the prominent French aeronauts to undertake experiments with aeroplanes is Capt. Ferber, of the artillery corps. Being a mathematician of great capability, he was able to make an extensive series of calculations upon the theoretical forms which should be best adapted for aerial flyers, and this he did at some length, though unfortunately these calculations (which are of an exclusively mathematical nature) are not well suited for reproduction. It must not be forgotten, however, that Capt. Ferber, besides being occupied with the theoretical part of the subject, is at the same time one of the first aeronauts in France to take up the construction of aeroplanes carrying one or even two persons. He is, in fact, a pioneer in this work, which has now reached such a successful development in France. At present he is engaged in constructing a new aeroplane with which he expects to experiment in the near future. Concerning the work which he has already carried out, he has kindly furnished the writer with the following information, together with views of his apparatus.

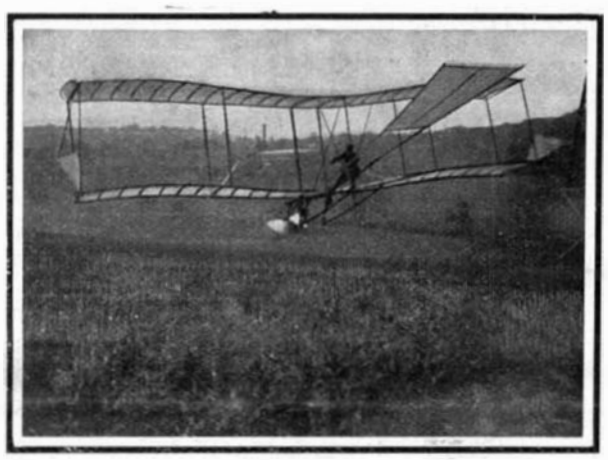
In the first place, he decided to abandon the horizontal or lying-down position of the aeronaut upon the frame, which is found to entail many disadvantages; and in the newer forms of apparatus he adopted a comfortable seat for the pilot. No doubt this acts to increase the air resistance to some extent, but this may be diminished in turn by using a light and inclosed frame which will have a suitably designed form with pointed end in order to bring the resistance down as low as possible. In the new design of flyer he adopted a tail of considerable length, which he found to be a decided advantage. Since the experiments of 1903 he has used side rudders on the aeroplanes, and these were built so as to have a powerful action. He was, however, obliged to make a number of experiments in order to find out the best design to give the rudders, for in the first trials of the apparatus, when he came to work them, he found that they had turned the aeroplane in just the opposite direction from what he expected. Another modification came in as regards the general curve lines of the aeroplane system, and from an esthetic standpoint at least the *ensemble* seems to have gained somewhat over the preceding type. In place of using sliding surfaces having the form of skates upon the bottom of the framework, he now employs a set of small rollers or wheels, so that the aeroplanes can be propelled easily along the ground by the action of the propeller. Since then many of the new aeroplane workers have adopted the idea of the wheels, as it enables the experimental flights to be easily carried out. Since 1904 Capt. Ferber has made considerable progress in his new aeroplane designs. Some of the forms which he adopted will be noticed in the accompanying views. The length of flight which he made in the different trials of the apparatus depends upon the experimental grounds, seeing that the trajectory is a straight line inclined at one-fifth and traversed at the rate of 7½ meters (24.6 feet) per second.

More recently he constructed an apparatus having two places in tandem, and in this way he was enabled to take a second person upon the aeroplane, this being somewhat of a novelty. With this apparatus he made a series of flights, having on board the aeronaut Burdin, who occupied the front seat, while Capt. Ferber governed the maneuvers of the aeroplane from the rear seat. The 88 kilogrammes (194 pounds) which were reserved upon the No. 6 aeroplane for the motive apparatus, including the motor complete with the fuel supply, besides the transmission shafts and gears, the propeller, and the frame, represented but 4 horse-power in 1901 and 6 horse-power in 1903, but in 1905 Capt. Ferber was able to secure 12 horse-power with the above weight. In his newer form of aeroplane he proposes to get 20 horse-power, or even more, out of the motor outfit, following the progress which has been made within a recent period in the construction of special light-weight gasoline motors. The No. 6 aeroplane was put through a series of trials at the grounds which were arranged specially for the purpose at Nice. It gave but 6 horse-power, however, seeing that this aeroplane is in fact the apparatus which he used as far back as 1903, somewhat modified in the leading



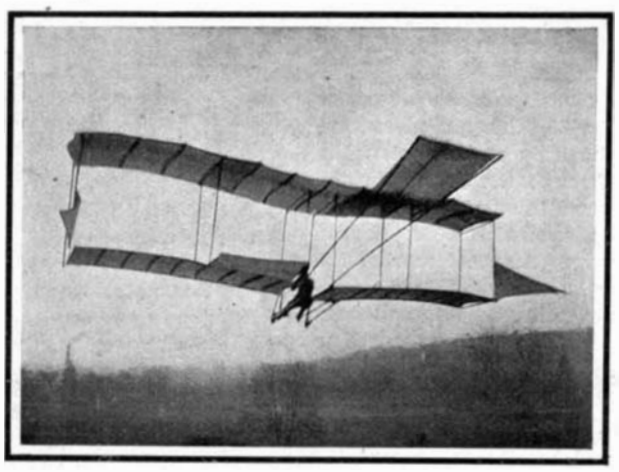
The Aeroplane Carrying Two Men and Making a Long Glide.

curves of the design; and it has therefore a better all-around form. Up to this time Capt. Ferber experimented with the aeroplanes attached to a wire when they were driven by the propellers, or, in other cases, they were allowed to sail downward from an elevated point. However, he was able to make a direct flight through the air on the 27th of May, 1905, this being the precursor of the more recent successful flights of Santos Dumont and others. The power which was given on this occasion by the 6-horse-power motor was not, however, enough to allow the aeroplane to make a flight along the ground and above the surface, as was done later on, but it was sufficient to reduce the original flying angle of one-fifth to one-seventh. Capt. Ferber expects to mount a new 12-horse-power motor upon this aeroplane, and he will then continue his experiments in the hope of obtaining some interesting results. Not long since, he had the apparatus stored at the government balloon establishment of Chalais-Meudon, in the suburbs of Paris, and a serious accident happened to it, as during a severe wind storm it was injured to such an extent that it will have to be almost entirely rebuilt. This mishap has been unfortunate in delaying the work which Capt. Ferber expected to carry out. He may be prepared, however, to enter the field during the present season, where his long experience will place him in the foremost rank.



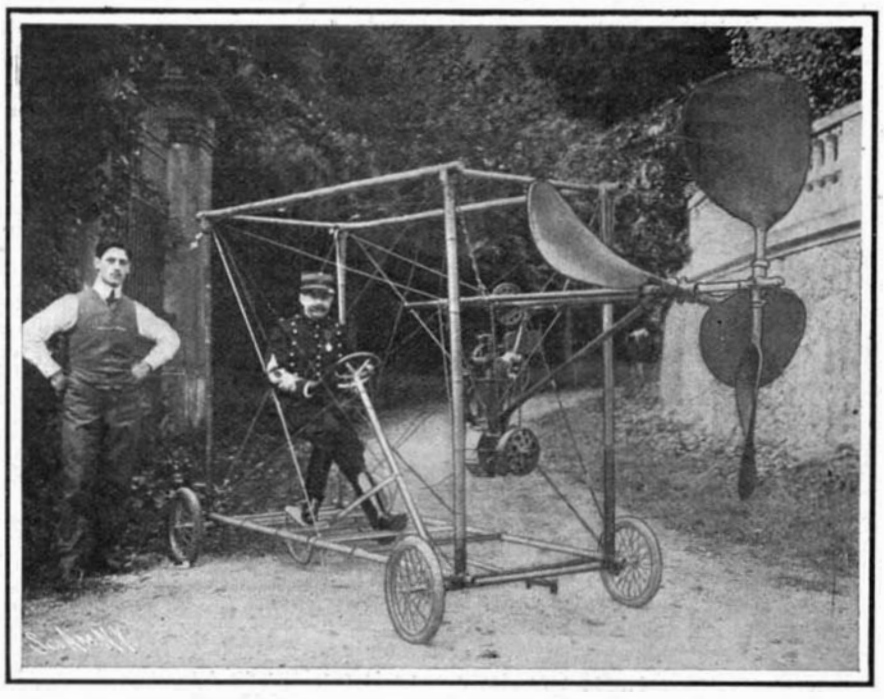
Capt. Ferber Making the First Flight in Europe with a Motor-Driven Aeroplane on May 27, 1905.

The aeroplane was raised with a wire, which was then cut. The 6-horse-power motor drove the machine a short distance at a downward incline of 14 to 20 per cent.



Capt. Ferber's 1904 Apparatus with Triangular Vertical Rudders at the Ends.

The aeroplane is shown while in the air during one of the test flights with the designer aboard. Note the curves of the surfaces and the lateral rudders for steering.



Capt. Ferber's Experimental Apparatus for Testing the Efficiency of Screw Propellers.

The apparatus is driven by a 9-horse-power Buchet motor which drives two 4-foot propellers mounted on a single shaft. Speeds of 56 miles an hour have been made with this apparatus.

What Indian Children Are Taught.

Coupled with the policy of industrial training of Indian children, says the Superintendent of Indian Schools, is a desire to preserve the native handicraft of the Indian. While in the shop it is planned to give each boy a general grasp of the essential principles and practical workings of the mechanical trades, yet the arts of their ancestors are taught when it is found that the children take any delight in those things. Effort is made to maintain the high artistic standards which have made Indian work famous and given it its greatest value. This involves the preserving of the symbolic tribal designs, and the using only of those dyes and materials which have been thoroughly tested by time and use.

Where tribes are represented who are adepts in particular arts, more prominence is given in the schools to instruction in those native industries. Thus in schools having a number of Navahoe or Moqui children, competent training in blanket weaving is provided. Specific instruction is given in stringing the warp upon the hand-made loom, carding and spinning of wool, and dyeing the threads to suit the pattern. The native Indians of the south half of the Navahoe Reservation weave annually more than one hundred and fifty thousand dollars' worth of blankets, and the quality is superior to that formerly made. About one-fourth of the support of these Indians is derived from the sale of Navahoe blankets woven under instruction given in the schools.

Beadwork is successfully taught at the Cheyenne school in Oklahoma, and many articles made there are readily sold. At Chilocco the girls are taught bead and drawn work; at Phœnix, Arizona, girls are taught blanket and basket making and bead work, while at the Pima training school basketry is taught. At some of the schools, especially in New Mexico, pupils are encouraged in pottery work, and some unique models in vases and jugs have been developed. Lace making and Mexican drawn work receive considerable attention in the schools of New Mexico.

These instructions in handicraft are only in keeping with the revival of the arts in America, and their introduction into the curricula of various educational institutions throughout the country.

But industrial training is not subordinated to instruction in the crafts. At the non-reservation training schools, where facilities are ample for giving practical instruction in the trades, the capabilities and aptitude of the pupil along certain lines are carefully noted, and he is given thorough and finished training, that he may be able, if necessary, to follow a particular trade after leaving school. Even in the reservation schools sufficient instruction is given to enable the pupil to build a barn or small house, and do such repair work as is necessary about the farm.

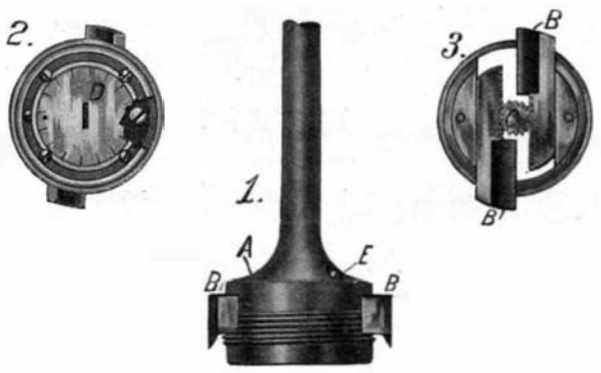
The girls are carefully instructed in general housework. They are taught sewing, plain cooking, butter making, and the care of milk, etc. Cooking is one of the chief accomplishments which an Indian girl needs to make her a successful housekeeper. To secure this, detailed directions and graded sample lessons, correlating cooking with language and number work, are given.

The system of industrial training, coupled with the crafts, is intended to bring civilization to the door of the Indian, rather than to undertake to bring him to civilization; and it is believed that the policy will strengthen the family ties and early sow the seeds of industry and self-reliance.

Patent Department

ADJUSTABLE BORING TOOL.

An improved form of boring tool of the class adapted to cut larger openings than are usually formed with an auger or bit, has recently been invented by Mr. John Dowling, of Olympia, Washington. The tool comprises a shank terminating at its lower end in

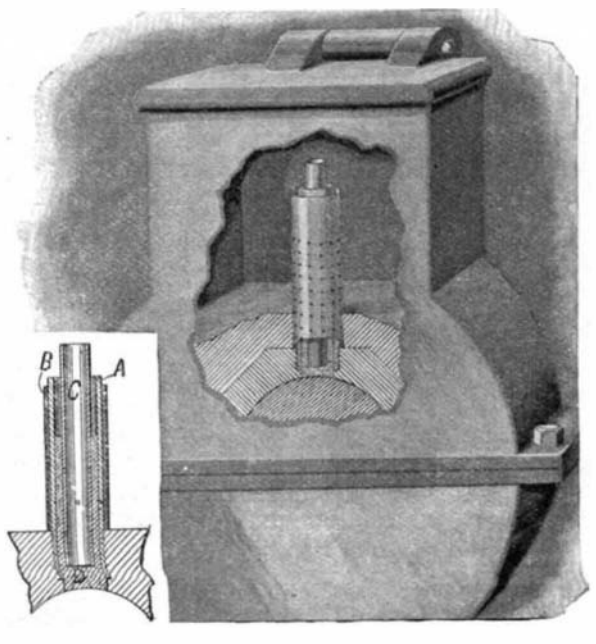


ADJUSTABLE BORING TOOL.

an enlarged body, as shown at *A* in the engravings. The threaded portion of the body consists of a cap which is secured to the tool by means of screws threaded into the bottom. The main body of the instrument is formed with a transverse slot in which a pair of cutters, *B*, are seated. These cutters are held in place by the cap just referred to. The bodies of the cutters are formed with rack teeth adapted to engage a pinion, *C*, as shown in Fig. 3. This pinion is journaled at its upper end in the body of the tool, while the opposite end projects through the bottom of the cap and is secured to or formed integral with a plate, *D*. The latter is revolubly secured to the bottom of the cap by means of screws. At the center of the plate is a slot adapted to receive a screw driver whereby the pinion may be turned and the cutters moved outward, or drawn inward to any desired extent. The plate, *D*, is graduated to indicate by its position the diameter of opening for which the cutters are set. In use a hole is first drilled to receive the body of the tool, and then when the cutters are set at the proper sweep, they are firmly secured by means of screws, *E*. The boring then proceeds, the threads on the cap serving to feed the body of the tool into the work. When it is desired to increase the diameter of an opening that is too large to snugly receive the threaded portion of the body of the tool, a thimble or sleeve is provided which is both internally and externally threaded. This thimble is screwed over the cap and its external thread serves to feed the tool into the work. If desired, a second thimble may be screwed over the first, and by having several thimbles of various sizes the tool may be adapted to a wide range of work.

LUBRICATOR FOR STREET RAILWAY MOTORS.

The armature bearings of street railway motors are, as a rule, lubricated with grease which does not operate until the bearings have become heated by friction. Such friction entails a considerable loss of power and causes the bearings to become worn in a short time. In the accompanying engraving we illustrate an improved lubricator adapted for using oil, and thus obviating the difficulties encountered in other lubricators. The lubricating oil is contained in a reservoir or chamber in the housing in which the armature

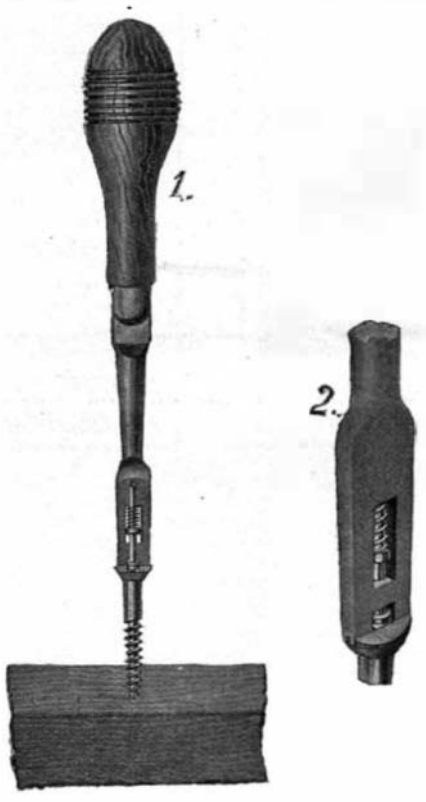


LUBRICATOR FOR STREET RAILWAY MOTORS.

shaft or car axle is journaled. Threaded at its lower end into the journal bearing is a tube *A*, which, near the journal, is formed with an aperture. This aperture preferably flares inwardly. Over the tube *A* is a casing *B* which is perforated to form a screen. Within the tube *A* is a tube *C*, open top and bottom, which carries a sleeve of felt. The latter projects below the tube *A* and bears against the axle. In use the lubricating oil passes from the chamber, through the perforations of the screen *B*, and through the aperture of the tube *A*, into the felt which surrounds the inner tube, *C*. The felt takes up and retains the oil and applies the same to the journal bearing. The outer screen, *B*, serves to prevent sand, dust, dirt, and other foreign matter from coming into contact with the felt. The inner tube, *C*, is also formed with apertures which facilitate the distribution of oil on the felt in starting up the motor in the morning or after filling the oil box. The inventor of this improved lubricator is Mr. John W. Hinchcliff, of Jackson, Miss.

SCREW DRIVER WITH A CENTERING DEVICE.

The difficulty of seating a screw driver in the head of a screw when the work is in an unhandy or obscure place, has led Mr. Clemence E. Hoffman, of Thomaston, Conn., to devise a radically new form of screw driver, which is here illustrated. This screw driver differs from the ordinary in having a double tip and a spring-actuated centering pin. The pin is mounted in a suitable bore in the screw driver and at the lower end it carries a rounded centering head, the tip being cut away at this point to allow for the head. A recess is formed near the lower end of the screw driver, exposing the pin, which, at this point, carries a spring seated between the upper end of the

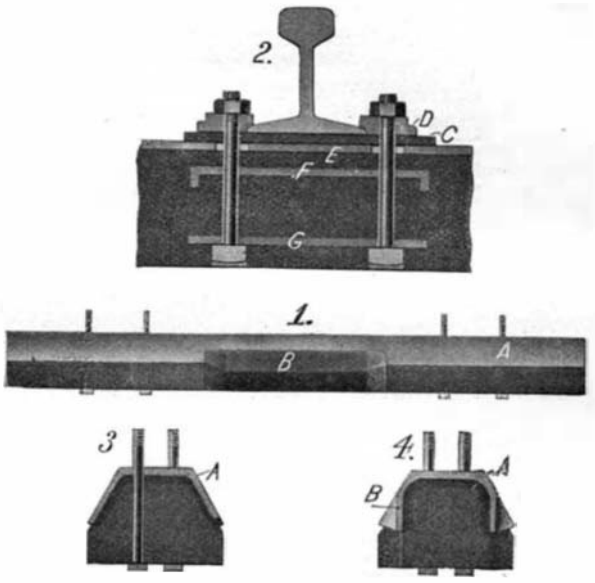


SCREW DRIVER WITH A CENTERING DEVICE.

recess and a shoulder on the pin. This spring serves to press the pin downward so that the head projects beyond the tip of the screw driver. In using the screw driver it is necessary to have screws of a special form, such as are clearly shown in the engraving. The screw heads are provided with a double groove and a central recess adapted to receive the centering head. In operation the screw is set in position and the screw driver tips are quickly applied to its head. The centering head of the pin can now be moved across the upper face of the screw head until it lodges in the central recess. The screw driver will then be forced downward, and at the same time rotated. As this takes place the centering pin will serve as an axis on which the screw driver may turn, and when the tips arrive over the grooves in the screw head, they will at once drop into position, after which the screw driver may be used in the ordinary manner. The screw driver, having a double tip, is much stronger and less apt to break than those having one tip. The invention is applicable to round-headed machine screws and round-headed wood screws, as well as to the type of screw shown in the illustration.

ARMORED-CONCRETE RAILWAY TIE.

In the accompanying engraving we illustrate an improved railway tie of the armored-concrete type. The tie is simple in construction and comparatively inexpensive to manufacture, as it employs only such materials as may be commonly found in the market. The plate shown at *A* is an ordinary trough plate with its flanges flaring outwardly. In order to prevent endwise displacement or creeping of the plate, the flaring flanges are bent to vertical position at various points. as indicated at *B*. In constructing the tie the trough is inverted and filled with concrete, which is molded to the desired thickness. Near each end of the tie a pair of bolts are molded in the concrete with their heads bearing against a plate imbedded in the bottom of the tie and their threaded ends passing through the armor *A*. These bolts are adapted to receive clips, such as shown at *D*, for securing the rail to the tie.

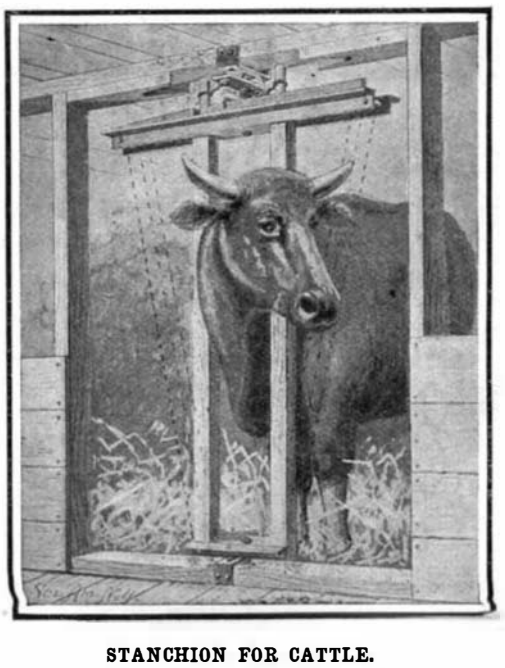


ARMORED-CONCRETE RAILWAY TIE.

Fig. 1 shows a special construction for supporting an insulated rail, such as the power rail of an electric railroad. A plate *C* of wood, fiber, or other insulating material, is placed between the rail and the armor *E*. The bolts which hold the clips *D* are countersunk and bear against a plate *G*. In order to provide additional strength to the tie, a plate *F* is embedded therein. The clips *D* are of unique form. They consist of solid blocks of metal so cut as to present the appearance of two square plates, one displaced with respect to the other, and overhanging it on two adjacent sides. Evidently, if the clip is reversed, the opposite two sides of the second plate will overhang the first plate. This provides four edges for each clip, which may be used to overlap the base of the rail and secure it to the tie. The inventor of this railway tie is Mr. Henry S. Kilbourne, 330½ Deaderick Street, Nashville, Tenn.

STANCHION FOR CATTLE.

In order to give to cattle a certain liberty of motion when in their stalls, Mr. John H. McGuire, of Heuvelton, New York, has invented an improved stanchion, which we illustrate herewith. This stanchion is so arranged that it may be rotated, or be moved forward and backward by the animals secured therein. It comprises a pair of upright bars pivoted at the bottom so that they can be swung toward or from each other. After placing the head of the animal between these bars, they are swung together and their upper ends are secured by means of a spring latch. A pair of guide rails serve to guide the motion of the bars. These rails are carried on a pivot bolt, the upper end of which engages a slot in a bracket secured to the ceiling or beam overhead. The block to which the lower ends of the bars are hinged is also mounted on a pivot and the pivot is free to move in the slot in a bracket secured to the floor. These slots are arranged to permit a limited forward and rearward motion to the bars, which have as well a pivotal motion on the pins. The upper ends of the bars are connected by links to a plate mounted on the upper pivot bolt. The latch or locking bar is also mounted on this pin below the plate and is connected therewith by a spiral spring. The latch is formed with notches on opposite sides in which the upright bars are held against the



STANCHION FOR CATTLE.

tension of this spring, so that when the latch is turned clear of the bars they will swing to the position shown by dotted lines in the engraving. When the bars are drawn together the spring reacting on the latch causes the latter to snap over the ends of the bars and lock them fast. The bars are not centrally pivoted at their lower ends, and their upper ends are cut away at one side so that by reversing one or both of the bars the stanchion may be adjusted to three different sizes to accommodate different sized animals.

RECORDING AUTO SPEED METER.

This ingenious device should meet with great favor among automobile owners, as it fills a long-felt want for an instrument that will give a written record of the performance of the machine for twenty-four hours.

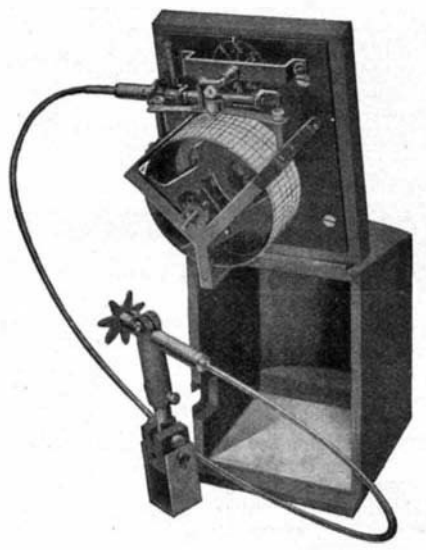
The record forms a diary by which the automobilist can see at a glance how many miles have been run during the twenty-four hours, the exact moment the start was made from any point, and the exact moment the destination was reached, as well as the number of miles covered, the rate of speed between each mile post, and also the number and duration of the stops.

The chart is 12 inches long, divided into four sections of six hours each. These are sub-divided into hours, half hours, quarters, and 5-minute spaces. As the hour spaces are 2 inches long, the records of each mile are very legible; in fact, 60 miles an hour can be recorded without difficulty and easily read at a glance.

As an illustration of such a record, suppose a run was to be made from New York to Philadelphia, the start being made at 9 o'clock A. M. From 9 o'clock to 9:45 thirty records are made; this shows thirty miles were covered, at a rate of speed of forty miles an hour. From 9:45 to 10 o'clock no records are made or the chart is blank, showing the machine was not in action during that period. From 10 until 10:15 fifteen records are made, or a speed of sixty miles an hour has been accomplished; and so on until Philadelphia is reached at 1:40 P. M., when the last record is made. The records show that it took four hours and forty minutes to cover the entire distance. The total number of records gives the number of miles, and the time between records indicates whether the machine was making 12, 20, 30, or 60 miles an hour.

The construction is exceptionally rigid, so that no amount of jarring can disarrange the mechanism or affect the accuracy of the clock movement. The case can be made of polished mahogany or aluminium, and the outside dimensions are only 5 x 4 x 3 inches, so that very little space is taken up on the dashboard.

The principle of construction is shown in the accompanying illustration. The clock movement is supported on a stationary shaft, around which it revolves, carrying a drum on which the record sheet is attached. The clock is geared to revolve four times in twenty-four hours, and one end of the shaft has a spiral thread so arranged that one revolution of the clock and drum causes the record chart to move horizontally one-quarter of an inch. In this way the records of the second, third, and fourth period of six hours are entirely distinct from each other. The spiral screw is engaged in such a manner that the clamp can be released and the drum instantly revolved or set, so that the recording pen can be brought to any desired minute or point on the chart so as to register the time of starting the machine.



RECORDING AUTO SPEED METER.

On the automobile is an adjustable clamp having a sprocket engaging with another sprocket mounted on the hub of the wheel. Each revolution of the wheel is carried up to the recording instrument on the dashboard by a flexible shaft having mounted at its upper end a pivotally supported worm shaft arranged to mesh with the gear wheel. This gear wheel has the required number of teeth, so that one revolution of the wheel represents an exact mile covered by the automobile wheel. The gears can be arranged to correctly record a mile regardless of the diameter of the automobile wheel.

Mounted in the center of the gear wheel is a shaft having at its end a cam engaged with a pen lifter, so at the complete revolution of the gear wheel or at the completion of the mile the cam allows the pen to drop down and make the recording mark on the chart.

A novel feature of the arrangement of the gear wheel is that it can be disengaged from the worm shaft and revolved by hand so as to bring it to zero, thus avoiding the necessity of running the machine a portion of a mile before the starting point can be recorded.

The pen is made of non-corrosive metal so as not to become clogged by the ink. The capacity of the pen fountain is sufficient to carry a week's supply of ink without refilling. The pen is suspended on a flexible steel band, so that no amount of jarring will cause a false record to be made or allow the ink to come out excepting at the completion of a mile or when the pen is allowed by the cam to mark the record.

The entire construction of the instrument is such that any one can mount the instrument on an automobile without difficulty. A patent covering its construction has been secured by C. F. Iszard, 241 Hansberry Street, Germantown, Philadelphia, Pa.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BODY-CONFORMER.—C. MUNTER, New York, N. Y. This corset device is adapted for rectifying the shape of the body at the hips and lower portion of the trunk, wherein a pliable material, such as cotton or silk cloth fabric, is cut in such a way as to be given a skin-tight fit to the body at such points by reason of the peculiar shape of the device, and, further, by reason of an arrangement of laces running through eyelets, the individual laces being joined to belt-straps connected by a buckle or its equivalent at the front of the device.

APRON-SUPPORTER.—J. G. KOUNTZ, Wellsville, Ohio. In this instance, means provide for supporting aprons worn by butlers, hotel-waiters, etc., and especially where the support is removed in laundering, and the inventor has for his object improved supporting means not only adapted for effectively supporting an apron on the user of the article, but which shall be readily attachable and detachable, providing for interchange of aprons, as occasion requires.

CLASP.—J. W. ALBIN and D. C. RICKETTS, Babylon, N. Y. This clasp is such as used for garment-fasteners. The invention is especially applicable in the construction of cuff-holders, but is for use in various connections. The device may be readily applied, and has a desirable flexibility, adapting the same to movements of the parts of one's body.

MIXED WHALEBONE FOR BODICES.—E. M. BOSSUET, 49 Boulevard Haussmann, Paris, France. This stay is extremely flexible and can be folded upon itself many times without breaking and the combination is much more resistant than the genuine whalebone, while possessing all its flexibility. The invention comprises a stiffener of two strips of resilient flexible material acting as a spring and a thin sheet of cork of a width and length equal to the strips, and interposed therebetween and to which the same are glued.

Electrical Devices.

INTERLOCKING TERMINAL BASE.—L. STEINBERGER, New York, N. Y. Mr. Steinberger's invention relates to terminal bases used in telephony and analogous arts, his more particular object being the production of built-up terminal bases of composite characters made of separable parts capable of interlocking and provided with appropriate electrical conditions. Preference is given for the use of the well-known insulating material designated as "electrose," in the construction of the base-sections. It has many of the properties of hard rubber.

INSULATOR-PIN AND SUPPORT THEREFOR.—L. STEINBERGER, New York, N. Y. The more particular object in this case is to provide a type of pin which can be securely mounted upon a cross-arm in such manner as to protect the same against undue action of moisture and also against strains due to the weight and to the swaying of the wire or cable. Another object is to provide a cross-arm which will less readily retain snow or moisture and to insulate this support more effectually, especially the portion adjacent to the insulator-pin.

INSULATING-CLAMP.—T. B. LEE, Charlotte, N. C. The main object of the inventor is to improve upon devices now in use, and to provide a clamp upon which as much strain may be put as may be necessary to hold the wire from slipping and to give it such clamping effect as to throw a required amount of friction on the wire, and to allow for more or less slipping over the top of the insulator. It consists broadly of an insulator-clamp comprising two separate sections to embrace the insulator-neck and suitable means for clamping the sections together.

INDICATOR.—C. VERSTEEG, Ashton, S. D. The present invention is an improvement over the device shown in Letters Patent formerly granted to Mr. Versteeg, and comprising an open electric circuit, including a signal to be operated by the contact of the terminals of the circuit, said terminals being arranged within the bin in position to be moved into contact by the movement of the grain when it reaches a predetermined depth in the bin, and in means for preventing the direct contact with the grain of the contact-points, while permitting their movement toward and from each other.

ELECTRIC MEDICAL APPARATUS.—C. VAN BERGH, Winnipeg, Manitoba, Canada. An object of the invention is to provide means for interrupting a current generated by a battery of any suitable kind, and, furthermore, to provide an interrupter which may run at very low speed and is noiseless in its operation. A special form of motor operates at such low speed that the current passing through it may be interrupted, and the intervals are so controlled as to correspond in time with the pulsations of the heart of the person treated.

Of Interest to Farmers.

PORTABLE FEEDER FOR THRESHING-MACHINES.—D. STILL, Milton, Ore. The improvement comprises a portable wagon-like body mounted on wheels for transportation, provided with longitudinal and transverse feed-aprons and picking and feeding devices, whereby grain is fed to an elevator leading to the feed-table of the thresher, the body being also provided with a derrick to facilitate the loading of the grain into the same and the feed-aprons of the device being connected by a suitable power-transmission shaft and universal joint to the power mechanism of the thresher.

CORN-HUSKING MACHINE.—W. S. RUSE, Twin Bluffs, Wis. In the present patent the invention has reference to certain improvements in corn-husking machines, and, more in detail, involves an attachment for said machines whereby the machine is prevented from clogging up, and all danger to the operator is obviated.

VINE AND WEED CUTTER.—C. F. HIPPARD, Minonk, Ill. One purpose of the invention is to provide a cutting attachment adapted for ready application to any type or size of cultivator and which will accomplish most effective work in killing any kind of weeds or vines that may be outside a row of corn, for example. It not only cuts and eradicates vines or weeds, but it pushes them midway between the rows.

Of General Interest.

DEVICE FOR INSERTING EXPLOSIVE CHARGES.—R. TORRAS, Brunswick, Ga. The invention refers to a device for use in connection with the insertion of explosive charges beneath stumps, rocks, sunken ships, or other bodies which it is desired to remove; and the object thereof is to provide a device simpler in construction and easier to operate than any heretofore known.

MUSIC-LEAF TURNER.—F. W. MCNEIL, St. Louis, Mo. The object of the invention is to provide a device by which the leaves may be turned either to the right or left by a musician using either a knee-lever or one of the handles. It comprises a plurality of pivoted arms having clamps to hold the leaves and provided at their pivot with segmental pinions which are successively engaged by racks carried by a sliding bar which is actuated by a pawl upon the movement of an operating-rod to either the right or the left.

APPLIANCE FOR SLIDING DOORS.—M. LOGAN, Plymouth, Ind. The object of this improvement is to provide a door with an effective and comparatively inexpensive means to keep it in engagement with the supporting rail or track and to prevent looseness or shaking at the bottom of the door, which, if unguarded, is the source of serious inconvenience, especially in windy weather.

APPARATUS FOR EXTRACTING BY-PRODUCTS FROM WOOD.—T. NEWNHAM, White Springs, Fla. This patent provides an apparatus for distilling wood, whereby essential oils and other useful products are obtained therefrom—such as turpentine, creosote, tar, and alcohol—by one continuous distilling operation without the necessity of interrupting the operation at any time to feed a new supply of wood or to draw off the by-products.

CAN AND MEANS FOR VENTING AND CLOSING SAME.—J. W. HEARN, New Orleans, La. The invention relates to cans and means for closing the same—such, for instance, as shown and described in the Letters Patent of the United States formerly granted to G. H. Dunbar. The object is to provide a can and means for venting and closing the same arranged to allow convenient venting of the filled can during the steaming and cooking process and to permit ready sealing of the can after the cooking and venting process is completed.

CAN-OPENER.—F. GARRECHT, Idaho City, Idaho. One object of the invention is to so construct the opener that it will lie flat on the top of the can where it is usually applied and have no projecting points from it, which is a source of much inconvenience in packing cans where this style of opener is used. Another object is to prevent accidental displacement of the opener from the top of the can.

CLINICAL THERMOMETER.—W. P. GRAFTON, 1 The Village, Old Charlton, Kent, England. The invention relates to clinical thermometers in which the return of the mercury to the bulb is brought about either by shaking or by centrifugal action; and the object is to enable the operation to be performed with the mimimum of trouble and without the liability of the thermometer slipping from the fingers and being broken.

VAULT-COVER MOLD.—J. H. DENNEY, Portland, Ind. In this operation of the device a series of wood forms are placed in position on a pair of strips and a lower matrix is placed thereon. An upper matrix is then placed in position, being retained in it by the top wood forms. The plastic material is then poured into the space between the matrices through the perforations for the reception of prints for cores, and after the setting of the cover it is removed from the mold.

THIMBLE.—E. BARNETT, Atlanta, Ga. In the present patent the object of the invention is to provide a new and improved finger-shield, more especially designed to facilitate the fastening of pin-tickets to cloth or other articles of merchandise without danger of injury to the fingers of the user.

Hardware.

HASP-FASTENER.—C. L. BAILEY, Morris, Ind. Ter. The invention is particularly adapted for use in connection with a hasp and staple, and to so construct the latch that it will be carried by the hasp in position for locking engagement with the staple, and, further, to so construct the said latch that the latch and hasp may be simultaneously operated by one hand, thus rendering the device desirable upon barn and similar doors as well as upon the doors of twine-boxes for reapers, binders, and the like.

Machines and Mechanical Devices.

COMBINATION POWER-MACHINE.—G. M. VROOME, Castleton Corners, N. Y. The patent shows a mechanism for producing power with the rise and fall of the tides and the invention provides a pit or well the top of which has inlets and outlets for the tidal water. A float has a guided movement in the pit and carries a rack-bar, which operates through suitable gearing and drums to raise a weight as the float rises, and as the tide recedes the downward movement of the weight serves to give a movement to a power-shaft in the same direction as the movement given directly to it by the float.

PULVERIZER.—N. SPURGIN, Ottawa, Ill. The principal objects of the invention are to provide means whereby the material upon entering the machine can be acted upon by a stronger force than that applied after the material is partially pulverized and to provide means for adjusting the walls of the pulverizer-chamber in such a manner as to take up wear and yet furnish a substantially circular interior at all times. It is especially adapted for use in disintegrating clay and similar substances.

MACHINE FOR MAKING COMPRESSED BUNGS.—C. SEYMOUR, Defiance, Ohio. This machine makes compressed bungs from a flat stick of wood and is arranged to insure a complete automatic action for feeding the stick

intermittently the desired distance for cutting off a square blank from the stick for the formation of the bung, for trimming the square blank to form a cylindrical blank and to compress the same into a bung of truncated-cone shape, and for stopping the machine when the end of the stick is reached.

Prime Movers and Their Accessories.

ELASTIC-FLUID TURBINE. — DEN-ICHIRO NISHIZAKI, No. 1 Tsuna-Machí, Mita, Tokyo, Japan. In operation, the fluid enters through throttle-valves and by the nozzles is directed against the innermost series of blades on the high-pressure side of the turbine. After having acted upon the innermost ring interposed guides deflect the fluid to the next ring of blades until the outermost ring has been acted upon, after which the fluid is deflected by guides toward the axes of the checking-valves, which are lifted into a chamber and from thence through to a chamber arranged circumferentially of the casing. From the latter chamber fluid is admitted by means of the check-valves through passages to the outermost ring on the low-pressure side, and after having acted upon all the rings on this side the fluid passes into the interior of the casing and to the condenser through an opening. Mr. Nishizaki has patented another elastic-fluid turbine, which is an improvement on his copending application formerly filed, and is designed especially to diminish losses of heat by radiation through the walls between successive pressure-chambers and to reduce axial thrust and obtain axial balance, as well as to diminish frictional loss to a minimum by reducing the number of running-wheels without sacrificing efficiency.

TURBINE - REGULATOR. — DEN - ICHIRO NISHIZAKI, No. 1 Tsuna-Machí, Mita, Tokyo, Japan. This invention relates to a system of elastic-fluid-turbine regulator to be used in connection with elastic-fluid turbines claimed in Mr. Nishizaki's previous applications; and its objects are to obtain results of very sensitive speed regulation with said turbines by reducing friction of the working parts of the regulator to the minimum, as it is known that friction destroys the sensitiveness of the regulator.

STEAM-TURBINE.—A. BONOM, New York, N. Y. In this case the invention has reference to steam-turbines, and the general purpose of the improvement is the production of a turbine which will be economical in steam consumption and of high efficiency. More specifically, the object is to produce a turbine which will be of compact form and in which the steam-space enlarges with the expansion of the steam.

Pertaining to Vehicles.

JACK.—W. UMSTEAD, Jerseytown, Pa. This invention relates to jacks, and is particularly useful in connection with devices of this character to be used for raising wagons off the ground for the purpose of removing the wheels. An object is to provide a device of this kind which can be used at various heights from the ground without adjustment and which can be operated by means of a simple manipulation.

DEVICE FOR SMOOTHING WAGON-ROADS.—F. W. LECHNER, Wenona, Ill. This device is adapted to be attached to any vehicle and used as a drag to smooth the road behind the said vehicle. It is well known that if roads are dragged with a harrow while soft they may be caused to dry up very much quicker, and in drying if the roads are repeatedly dragged deep ruts and grooves are avoided and a smooth hard surface is left when the ground becomes thoroughly dry.

BUGGY - TOP - PROP ATTACHMENT. — G. LAKE, Memphis, Tenn. In this patent the invention has reference to improvements in attachments for top-props for buggies, its object being to provide a device for receiving and holding the bow of a folding buggy-top and take up the jar and jolting usually received by the bow of buggies when the top is lowered.

SLEIGH.—H. A. LE BARON, Ridlonville, Maine. Bob-sleighs are improved by this invention. The object is to provide a sleigh that will be light, but strong, and so constructed that the runners will have a yielding or swinging movement relatively to the body, thus preventing to a great extent strain or possible disturbing of the load in the vehicle when the runner strikes or passes over an obstruction.

SPRING-WHEEL.—J. H. FAWKES, Detroit, Mich. This invention is an improvement in spring-wheels. By the use of the improved wheel a considerable amount of rubber is saved in the tire, since one-half of the ordinary tire is dispensed with, thus permitting the construction of tires of greater diameter with the same amount of rubber as now used in tires of much smaller diameter.

Designs.

DESIGN FOR A SOCKET FOR INCANDESCENT ELECTRIC LAMPS.—J. A. MEBANE, South Boston, Va. The socket in this design is approximately bell-shaped, and the body has exteriorly a series of parallel vertical rounded ribs and intervening grooves, the lower ends of said ribs running out on the flared base or rim of the socket and terminating in acute angles or points.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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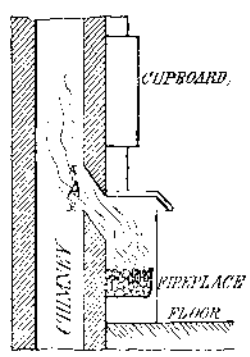
Minerals sent for examination should be distinctly marked or labeled.

(10491) L. B. J. asks: I am confused on this problem: Hiscox says, in "Gas, Gasoline, and Oil Engines," page 65, "having 120 volts 24 amperes, resistance was cut in to give 110 volts and 21 amperes." Now, what was this resistance? I compute as follows: 120 less 110 gives 10 volts as the drop, which divided by 21 gives about 0.5 of an ohm as the resistance. Yet 120 volts through 0.5 ohm resistance gives, as I understand, 240 amperes. I know that I must be wrong. Please explain in Notes and Queries. What if the amperage was 1, 12, or 48 instead of 24? In these cases what would be the resistance and the amperage? That is, in dropping to 110 volts. A. If with 120 volts 24 amperes flow, the resistance must be 120 divided by 24, or 5 ohms. If with 110 volts 21 amperes flow, the resistance must be 110 divided by 21, or 5.24 ohms. The resistance needed to make this change is 0.24 ohm. If with 120 volts 12 amperes flow, the resistance must be 120 divided by 12, or 10 ohms. As the resistance was 5.24 ohms when with 110 volts 21 amperes flow, we must add 4.75 ohms to bring about the change. In the same way for any other numbers.

(10492) T. J. writes: Will you please inform me how to bleach yellow feathers white on a live bird? A. Peroxide of hydrogen is the only chemical that can be used on a *live* bird without danger to the animal. This chemical is the one that is extensively used for bleaching hair.

(10493) H. B. asks: At how many revolutions a minute could a solid cast-iron disk be run with safety—the disk having the following dimensions: Diameter, 5 feet 6 inches: thickness at hub, 4 inches; and tapering to ¼ inch thickness at the rim. We mean, of course, if this were running free, and were not acted on by any other forces except centrifugal force. A. The disk may be run at a speed of 550 revolutions per minute with a safe factor of from 5 to 6, depending upon the quality of the iron. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 891, on centrifugal force as applied to revolving machinery; 10 cents mailed.

(10494) R. D. says: I have been a reader for a number of years, and for this reason felt that I might impose on your good nature by asking if you could tell us whether or not we could put a fireplace in our chimney without spoiling the draft for the other connections. There are only two openings into it, both in the basement. We want to put the fireplace on the first floor if possible. Our local masons do not know much about fireplace making. If possible, please make a rough sketch of what you would suggest. If it was a double-flue chimney we could no doubt arrange it easily, but we have only one



flue to work on. A. In reply to your inquiry regarding the placing of a fireplace in your chimney, we would say that unless there was plenty of draft to spare in the chimney a fireplace would greatly reduce the draft in the chimney. The opening for the fireplace must be smaller than the two openings in the basement and should be arranged as shown in the sketch. However, unless there is plenty of draft to spare, it would not be advisable to put in the fireplace; and as we have no means of determining the draft, we cannot definitely advise you concerning this subject.

(10495) H. F. says: Can you give me a process to treat linotype metal that has deteriorated in quality through constant remelting, other than by adding old type metal or new linotype metal? A. Linotype metal for remelting should be kept free from all substances which do not belong there. The addition of a very little zinc or brass, etc., will make the metal unfit for use. The addition of type, stereotype or electrotype plates should also be avoided, as these are made on different formulas, and would, of course, change your mixtures. If your metal works poorly, send a sample to a reliable concern for analysis, who will supply you with a "tempering metal" to suit the condition of your metal.

(10496) B. G. W. asks how to charge magnets. A. Correspondents frequently ask the following questions, which are fully answered in their order: 1. For a plain description of how to proceed in order to charge a straight bar of steel with sufficient magnetism to give it the power of lifting four times its own weight. Also how to proceed with horseshoe and other forms. 2. The name of the best brand of steel to use—Jessup's, chrome, black diamond, tool or machinery. How to temper. 3. Is there any gain in allowing the bar to remain under the influence of the current for a long time, or does it receive the full charge instantaneously? In fact, we would like some information on this subject that we can rely upon. A. 1. The quickest and best way to magnetize steel bars is to place them centrally in a suitable coil, and then connect the helix with the wires from a dynamo-electric machine or powerful battery for a few seconds, remembering to break the current before removing the magnet from the coil. If the source of the current is a dynamo machine, the coil should be about 2½ inches long and should consist of 10 or 12 layers of No. 12 magnet wire. If a battery is used, a coil 1½ inches long, composed of 14 or 16 layers of No. 16 magnet wire, will be the best. The internal diameter of the coil should be only large enough to admit the bars easily. A battery of six Grenet elements, each having an effective zinc surface of 30 square inches connected in series, will do the work very well on small magnets; such, for instance, as are used in telephones. Where a number of magnets are to be made at one time the bars may be passed in a continuous line through the coil, always keeping three bars in contact end to end, adding one above the coil before taking one off below. In this manner sixty bar magnets have been strongly charged in ten minutes. Horseshoe magnets cannot be charged so readily. There are two or three ways of charging them. One way is to place them in contact with the poles of a very strong electro-magnet, removing them after breaking the current; another method is to place each limb of the magnet in a coil adapted to the current to be used, and still another method is to employ a single coil, inserting one pole of the magnet into the coil in one direction, then breaking the current, and inserting the other pole into the coil from the opposite direction. It is well to remember that the magnet will be very much impaired if the current is not broken before removing it from the coil. The secret of success in charging magnets is to have a strong current. It is impossible to make magnets satisfactorily without this all-important requisite. 2. As to the quality of steel best adapted to this purpose, machinery steel hardened and not tempered answers admirably. For horseshoe magnets German spring steel is the best. Tool steel answers well if hardened and drawn to a staw color. 3. The steel receives its maximum charge almost instantly. It is useless to allow it to remain under the influence of the magnetizing current more than a few seconds.

(10497) C. L. asks how to make a pad for rubber stamps. A. The following is said to be a cushion that will give color permanently. It consists of a box filled with an elastic composition, saturated with a suitable color. The cushion fulfills its purpose for years without being renewed, always contains sufficient moisture, which is drawn from the atmosphere, and continues to act as a color stamp cushion so long as a remnant of the mass or composition remains in the box or receptacle. This cushion or pad is too soft to be self-supporting, but should be held in a low, flat pan, and have a permanent cloth cover. The composition consists preferably of 1 part gelatine, 1 part water, 6 parts glycerine, and 6 parts coloring matter. A suitable black color can be made from the following materials: 1 part gelatine glue, 3 parts lampblack, aniline black, or a suitable quantity of logwood extract, 10 parts of glycerine, 1 part absolute alcohol, 2 parts water, 1 part Venetian soap, 1-5 part salicylic acid. For red, blue, or violet, 1 part gelatine blue, 2 parts aniline of desired color, 1 part absolute alcohol, 10 parts glycerine, 1 part Venetian soap, and 1-5 part salicylic acid. The following additional receipt is also used for this purpose: 1. Mix and dissolve 2 to 4 drachms aniline violet, 15 ounces alcohol, 15 ounces glycerine. The solution is poured on the cushion and rubbed in with a brush. The general method of preparing the pad is to swell the gelatine with cold water, then boil and add the glycerine, etc.

(10498) J. M. H. asks how to prepare and polish shells. A. 1. Porcelainous shells are so hard as to require the apparatus of a lapidary to cut or polish them, but they are generally so smooth as to require no rough grinding. They may be polished by using a felt wheel and applying putty powder. Nacreous shells or those of the pearl variety may be filed and cut without a great deal of difficulty. Pieces to be turned are first roughly shaped on the grindstone, then turned and polished with pumice stone, putting on the final polish with rottenstone. Irregularly shaped pieces are filed and ground, then smoothed with pumice stone and water, and finished with rottenstone. The rottenstone is sometimes mixed with sulphuric acid full strength, or slightly diluted, to heighten the polish. 2. Rough shells are polished by first grinding them on a coarse stone, then smoothing them with pumice stone and water on a buffer wheel or with a hand polisher, and finishing with rottenstone.

(10499) A. N. M. asks how to color meerschaum. A. Ordinarily the pipe is boiled for coloring in a preparation of wax which is absorbed, and a thin coating of wax is held on the surface of the pipe, and made to take a high polish. Under the wax is retained the oil of tobacco, which is absorbed by the pipe, and its hue grows darker in proportion to the tobacco used. A meerschaum pipe at first should be smoked very slowly, and before a second bowlful is lighted the pipe should cool off. This is to keep the wax as far up on the bowl as possible, and rapid smoking will overheat, driving the wax off and leaving the pipe dry and raw. A new pipe should never be smoked outdoors in extremely cold weather. 2. Fill the pipe and smoke down about one-third, or to the height to which you wish to color. Leave the remainder of the tobacco in the pipe and do not empty or disturb it for several weeks, or until the desired color is obtained. When smoking, put fresh tobacco on the top and smoke to the same level. 3. When once burnt the pipe cannot be satisfactorily colored, unless the burnt portion is removed and the surface again treated by the process by which meerschaum is prepared. The coloring is produced by action of the smoke upon the oils and wax which are superficially on the exterior of the pipe, and are applied in the process of manufacture.

(10500) A. G. H. asks for rules for calculating speed of pulleys. A. The diameter of the driven being given, to find its number of revolutions. Rule.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the diameter of the driven; the quotient will be the number of revolutions of the driven. Example.—Twenty-four inches diameter of driver × 150, number of revolutions, = 3,600 ÷ 12 inches diameter of driven = 300. The diameter and revolutions of the driven being given, to find the diameter of the driven, that shall make any given number of revolutions in the same time. Rule.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the number of required revolutions of the driven; the quotient will be its diameter. Example.—Diameter of driver (as before) 24 inches × revolutions 150 = 3,600. Number of revolutions of driven required = 300. Then 3,600 ÷ 300 = 12 inches. The rules following are but changes of the same, and will be readily understood from the foregoing examples. To ascertain the size of the driver. Rule.—Multiply the diameter of the driven by the number of revolutions you wish to make, and divide the product by the required revolutions of the driver; the quotient will be the size of the driver. To ascertain the size of pulleys for given speed. Rule.—Multiply all the diameters of the drivers together and all the diameters of the driven together; divide the drivers by the driven; the answer multiply by the known revolutions of main shaft.

(10501) A. L. W. asks for a simple rule for calculating the horse-power of steam engines. A. Multiply the square of the diameter of the cylinder in inches by 0.7854, and this product by the mean engine pressure, and the last product by the piston travel in feet per minute. Divide the last product by 33,000 for the indicated horse-power. In the absence of logarithmic formulæ or expansion table, multiply the boiler pressure for ⅝ cut off by 0.91, for ½ cut off by 0.85, ⅜ cut off by 0.75, 3-10 cut off by 0.68. This will give the mean engine pressure per square inch near enough for ordinary practice, for steam pressures between 60 and 100 pounds, always remembering that the piston travel is twice the stroke multiplied by the number of revolutions per minute.

(10502) B. G. I. asks how to preserve India rubber. A. 1. In the opinion of Hempel, the hardening of vulcanized India rubber is caused by the gradual evaporation of the solvent liquids contained in the India rubber, and introduced during the process of vulcanization. Guided by this notion, he has made experiments for a number of years in order to find a method for preserving the India rubber. He now finds that keeping in an atmosphere saturated with the vapors of the solvents answers the purpose. India rubber stoppers, tubing, etc., which still possess the elasticity, are to be kept in vessels containing a dish filled with common petroleum. Keeping in wooden boxes is objectionable, while keeping in air-tight glass vessels alone is sufficient to preserve India rubber for a long time. Exposure to light should be avoided as much as possible. Old hard India rubber may be softened again by letting the vapor of carbon bisulphide act upon it. As soon as it has become soft, it must be removed from the carbon bisulphide atmosphere and kept in the above way. Hard stoppers are easily made fit

for use again in this manner, but the elastic properties of tubing ca not well be restored.—Ber. Chem. Ges. 2. In order to prevent India rubber materials from hardening and cracking, they are steeped in a bath of melted paraffin for a few seconds, or several minutes, in accordance with the size of the articles, and then dried in a room heated to about 212 deg. F.

(10503) C. N. asks how to bottle horseradish. A. Six tablespoonfuls scraped or grated horseradish, 1 tablespoonful white sugar, 1 quart vinegar. Scald the vinegar; pour boiling hot over the horseradish. Steep a week, strain, and bottle. Exposure to the air will discolor.

NEW BOOKS, ETC.

POCKETBOOK OF AERONAUTICS. By Major Hermann W. L. Moedebeck, in collaboration with O. Chanute and others. Translated by W. Mansergh Varley, B.A., D.Sc., Ph.D. London: Whittaker & Co., 1907. 14mo.; pp. 426; 140 diagrams and illustrations. Price, $3.25.

This book is a comprehensive *résumé* of the entire subject of aeronautics. It is written by a well-known German authority, and has been brought up to date by the various collaborators. The book contains sixteen chapters dealing with such subjects as physics of the atmosphere; meteorological observations in balloon ascents and the computation of results; the technology of gases; the theory, practice, and technique of ballooning, and ballooning from a military standpoint; kites and parachutes; animal flight; artificial flight; airships; flying machines; motors and air screws. All of these subjects are treated in detail. The section of the book dealing with balloons and ballooning is very complete, and includes a brief history of military ballooning in all the different countries. The question of firing projectiles at and from balloons and airships is also discussed, and there is an interesting chapter on balloon photography.

The section on artificial flight is divided into three parts. The first of these is historical, and the other two, by Otto Lilienthal and Octave Chanute, respectively, treat of this subject from a practical standpoint, and describe the various machines of different inventors with which experiments have been made, besides giving the theories of the action of the air upon plane and curved surfaces. The book contains reproductions of a number of excellent photographs of Lilienthal and the Wright brothers in gliding flight. A letter of the Wright brothers, written November 17, 1905, in which they detail their final successful flights with a motor-driven aeroplane, is reproduced. Chapters XIII. and XIV. on flying machines and on motors (by Major Hermann Hoernes) treat very elaborately of the laws of air resistance found by various experimenters, the fundamental laws of aerodynamics, aerodynamical calculations, etc.; and of all kinds of motors such as electric, steam, and gasoline, that come useful to the aeronaut. The Major also has a chapter on air screws, which will be found valuable. The book also contains a list of the different international aeronautical societies, of which there are over a score throughout the world. An Appendix gives many valuable tables and formulæ.

TUNNEL SHIELDS AND THE USE OF COMPRESSED AIR IN SUBAQUEOUS WORKS. By William Charles Copperthwaite, M.Inst. C.E. New York: D. Van Nostrand Company, 1906. 4to.; pp. 390; 260 illustrations and diagrams. Price, $9.

This is an elaborate treatise on the tunneling shield and its use in subaqueous work. The book has been compiled from papers printed in the Proceedings of the Institution of Civil Engineers, and from descriptions of tunneling work that have appeared in technical journals. The author is a man of considerable experience in this line of work. He discusses the shield from the date of its invention in 1818 up to the present time, and illustrates all of the various types that have been designed and put in operation. The book contains a chapter on the use of compressed air in engineering work, with some notes on caisson disease. Another chapter discusses the use of cast-iron lining in tunnels. The shield which was the invention of Mr. Alfred E. Beach, one of the original editors and proprietors of this journal, and with which he constructed a tunnel beneath Broadway in 1869 is illustrated and described. The Greathead shield, which was invented and used about the same time in England, is also discussed in Chapter IV. Other chapters are devoted to the use of the shield in water-bearing strata and the use of the shield in masonry tunnels. Chapter X describes the recent tunneling work carried out in England and in France by means of a shield, or with compressed air. The final chapter of the book is a practical one on the cost of construction and operating a shield. The book is completed by two Appendices giving a chronological list of events connected with tunneling by means of a shield or compressed air, and also giving English patents relating to this manner of tunneling from 1818 to 1904 inclusive. This book is especially recommended to engineers or others wishing to become familiar with this fascinating subject.

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AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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Agricultural implement, D. S. Capron 849,202
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Block signal system, E. F. Bliss 848,959
Boat lowering and detaching apparatus, O. P. E. Knudsen 848,998
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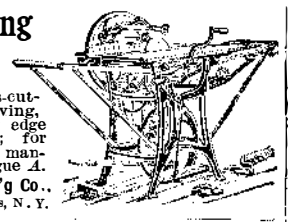

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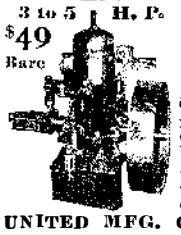

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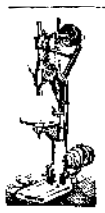

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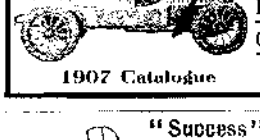

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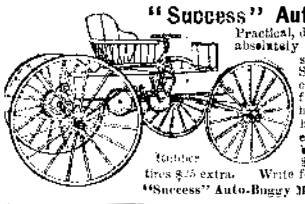

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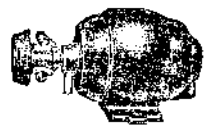

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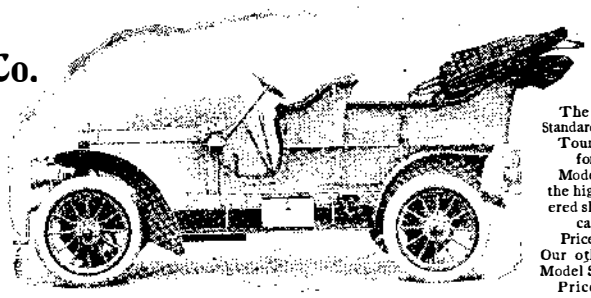

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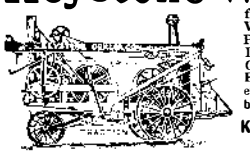

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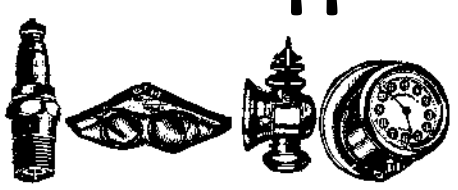

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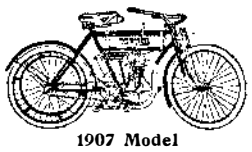

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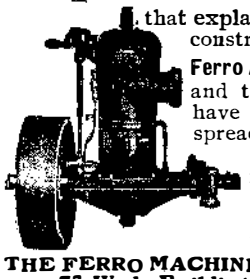

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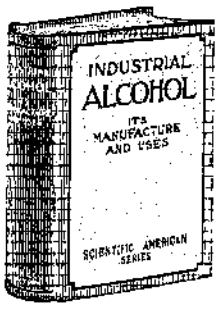

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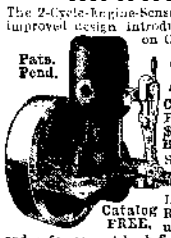

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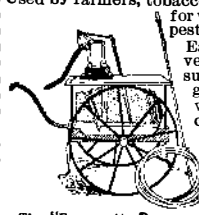

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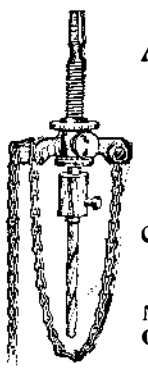

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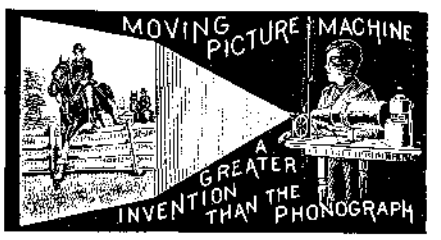

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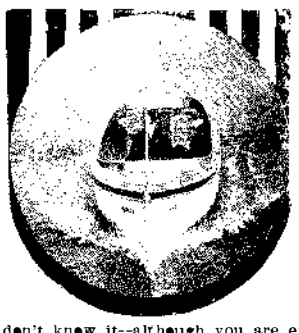

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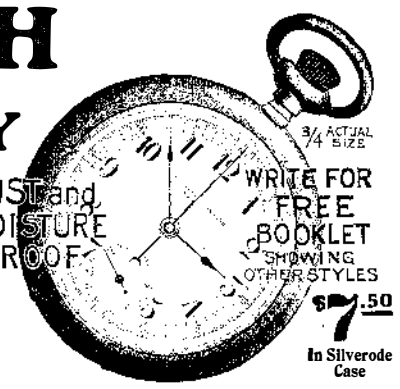

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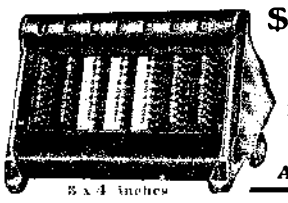

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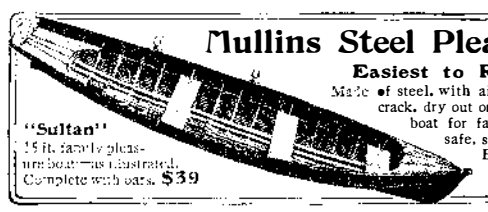

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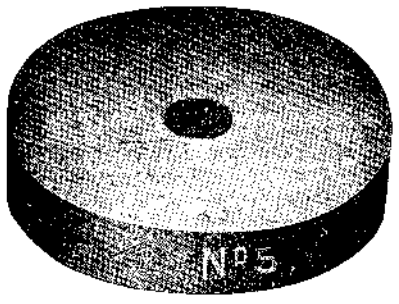

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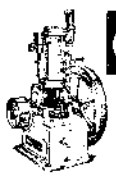

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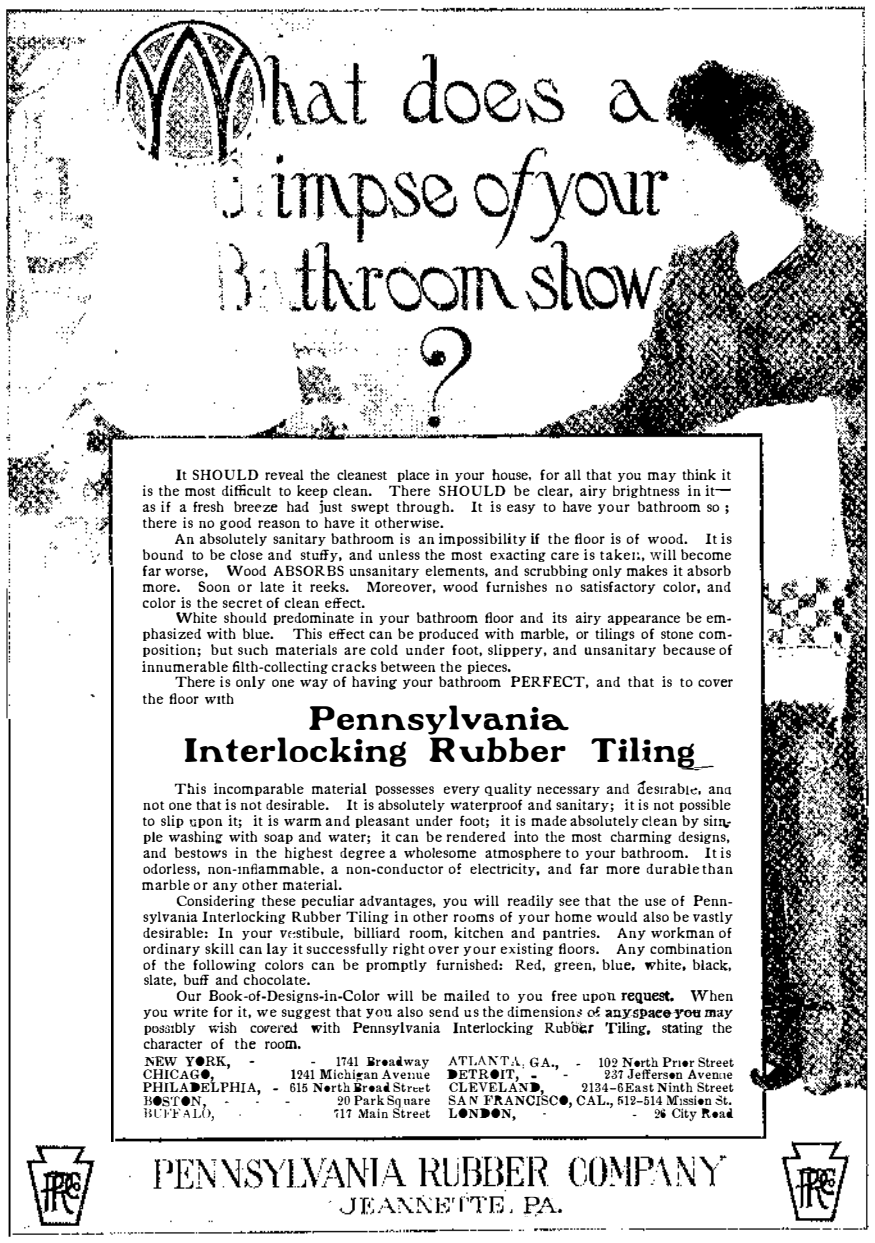

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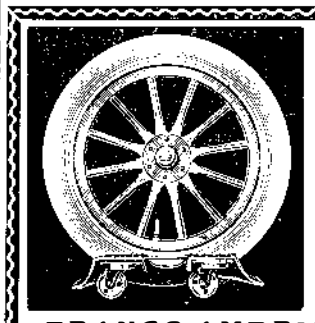

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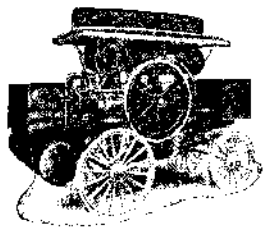

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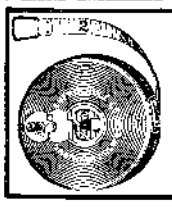

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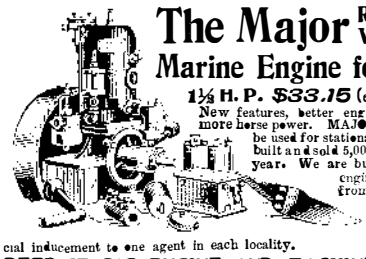

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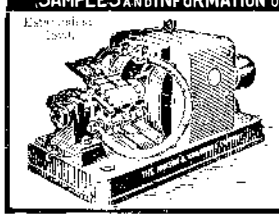

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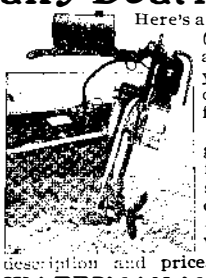

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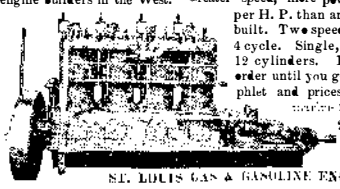

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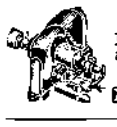

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